THE SCENT OF FLOWERS AND LEAVES: ITS PURPOSE AND RELATION TO MAN

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BY

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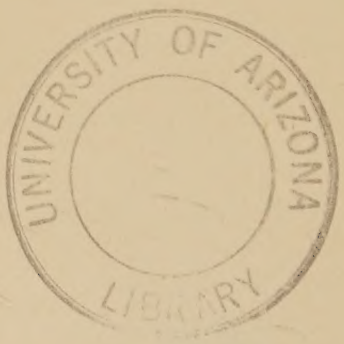
"Intellectually, we know, smell does not rank so highly as the other two senses, but it is, on the other hand, more emotional, and stirs the mind more deeply than seeing or hearing."—W. H. HUDSON: *A Hind in Richmond Park.*



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PREFACE

FROM the human point of view the scent of a plant is a large part of its beauty; from the point of view of the plant (if the metaphor is permissible) it plays an important part in its adaptation to life, and in putting together the facts that have been collected from these points of view the author has had in mind the possibility that the two may sometimes be related.

The scent of plants has been investigated in detail by perfumers and the chemists in their service, and it has occasionally attracted the attention of botanists, but the result of their researches is not very easily accessible to the gardener and the general public. It has therefore seemed worth while—on the assumption, which may be unduly optimistic, that the subject is of general interest—to gather together some of the facts and theories that are related to the scent of plants and to try to present them in a simple and coherent way.

The authoritative works of Parry, Gildemeister and Hoffmann, and Dr. M. P. Otto have been largely drawn upon, especially for chemical data, and the author is greatly indebted to the editor of the *Perfumery and Essential Oil Record*, for his courtesy in placing the past numbers of the journal at his disposal with permission to quote from them,

and to Messrs. J. N. Taylor, of Mortimer Street, London, for much technical information.

The short bibliographies at the end of each chapter are intended partly as indication of the sources of the material, but principally as references for the reader who may wish to follow up the subject of the chapter.

The author is greatly indebted to many friends for generous help in providing specimens of plants and records of observations; especially to Mr. Herbert Cowley, the editor of *Gardening Illustrated*, to the editor of *The Garden*, and to Mr. N. G. Hadden, of West Porlock, and to Mr. H. H. Warner. Lastly, but far from least, to Mr. James Douglas, of Bookham, for his observations on the scent of Carnations, and to Mr. H. R. Darlington and Mrs. Darlington for their criticism of the section on the Rose and for very kindly providing a list of scented Roses. To all these, and to others who will recognise their contributions, the author offers his grateful thanks and appreciation.

CHESHAM BOIS,
August, 1925.

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CHAPTER I

THE SENSE OF SMELL

THE sense of smell in man, whatever it may have been in the past, is now almost entirely a means of pleasure, a hedonistic sense, the loss of which scarcely impairs the efficiency of the organism.

It has a slight warning value in making us intolerant of defective sanitation and aware of decomposition in our food, but this last function is easily overrated, for even carrion is not necessarily poisonous, since many primitive races live on it for preference and take no more harm than we do from our appreciation of a well-hung pheasant. Many poisonous substances are odourless, and at least one, prussic acid, is sufficiently pleasantly scented to make it necessary to warn students in the chemical laboratory against the attractions of potassium cyanide.

The pleasure value of the sense of smell is usually underrated because we fail to realise that all that we call "flavour" in food is an olfactory sensation. The apparatus of taste in the mouth can only

appreciate the qualities sweet, sour, bitter and salt, so that when the sense of smell is put out of action by a severe cold it is impossible to distinguish an apple from an onion with the eyes shut, though we can still tell whether our tea is sweetened. The sense of smell may also be shut off by holding the nose firmly, and although, as some of us may remember, this does not diminish the bitterness of nasty medicines, it will be found to prevent us effectively from " tasting " an onion.

We do more smelling by way of the palate than through the nose, and our epicureanism has kept up the acuteness of our sense of smell and perhaps saved it from degeneration. For it remains remarkably sensitive, and our alertness to a trace of garlic in a bowl of salad is at least as impressive as our ability to detect $\frac{1}{276,000,000}$ grain of chlorphenol in 50 cubic centimetres of air.

The discriminating power of the sense of smell is also extremely fine, and a good wine taster can identify thirty or more varieties of wine with his eyes shut. But the wine taster's skill falls at once to the ordinary level when he is tested with wines to which he is not accustomed; for this faculty of discrimination is only brought out by education and interest. So soon as we begin to take an interest in scents, in those of flowers for example, we begin to notice differences that were formerly unperceived, and we get the impression that our sense of smell is becoming more acute, though we are only realising its keenness and making use of it.

The apparatus of the sense of smell is very simple

and very primitive. It is lodged in two small areas of mucous membrane in the upper part of the nose and consists of spindle-shaped cells, from each of which a number of short, slender rods of a waxy substance ("the olfactory hairs") project into the layer of watery mucus that bathes the interior of the nose. The olfactory cells enjoy a direct communication with the central nervous system by way of a prolongation of the brain itself which ends round them in a meshwork of nerve fibrils. The olfactory mucous membrane is slightly pigmented, and although the function of the pigment has not been discovered it probably plays some useful part, since dark hair seems to be associated with a keen sense of smell (most perfumers are dark-haired) and albinos are usually unable to smell at all.

The olfactory area lies a little above and to one side of the main stream of entering air, so that to obtain the maximum appreciation of a faint scent it is necessary to give a short sniff, which brings the scented air eddying sharply over the perceptive area.

The outgoing current of air is directed passively over the olfactory area, so that if we breathe habitually through our noses, as we should do, the scent of any substance that is being swallowed is carried automatically over the olfactory area and no extra effort is required to appreciate it. But if we examine the action of tasting the bouquet of a wine we shall find that, besides ever so discreetly smacking our lips, we breathe out gently and slowly through the nose.

There are several theories of olfaction, but it is now generally accepted that the molecules of the odorous substance must come into direct contact with the olfactory cells, and the theory that odour is due to some kind of vibration or emanation given off by the odorous substance has very little evidence to support it.

What the molecules of the odorous substance do after they reach the olfactory cells is still a field for speculation; we only know that they disappear as such, presumably into chemical or close physical combination with the material of the cells. This disappearance can be easily demonstrated by breathing a scented air through the nose and then immediately out again, when it will be found to have become scentless.

Since the receptive rods of the olfactory cells are composed of a waxy substance and are covered by a watery mucus, it follows that all odorous substances must be soluble in fats as well as in water. They must also be sufficiently volatile to reach the nose in vapour form. It will be found that all odorous substances fulfil these conditions.

There is almost certainly some relation between the architecture of the odorous molecule and the quality of the sensation that it produces, but, although a knowledge of the relationship would be of the greatest value to the perfumer and has been the subject of much research, it still remains hazy and obscure. One fact seems fairly sure, that the odorous substance must possess, in addition to the properties already mentioned, the quality of residual

chemical affinity. A quality that may be roughly described as a subdued and potential kind of chemical activity.

Those who are interested in the theories of olfaction will find them very fully set out in a monograph by T. H. Durrans (see bibliography at the end of the chapter).

The scent of a given substance is recognisably the same wherever we meet it, but the feeling that it evokes is strongly qualified by its setting and associations. The smell of roast beef is pleasant enough in the right place at the right time, but when it occurs in the leaf of an iris we call the plant "fœtidissima." When we look at this phenomenon from the opposite angle, it is equally difficult to understand why certain unpleasant smells, such as those of onions, cheese, game, etc., become pleasant when they are associated with certain gustatory impressions.

The odour of some substances changes with dilution, and so much that the scent of a strong and a very weak solution may seem to have nothing in common. Few substances show this change so well as indol, which smells disgustingly like a sewer when strong, but like narcissus when very dilute. This phenomenon, which probably belongs to the reaction of the individual and not to any peculiarity of the odorous substance, will be referred to again in Chapter IX.

The olfactory apparatus is very liable to be fatigued, especially by certain scents such as musk and violet, a reaction that, unlike the last, is shown

also by colour vision and taste. Recent work by Zwaardemaker and his pupils has shown that when the olfactory nerve endings have been fatigued by a scent until they are insensitive to it, they become insensitive also to certain other scents which resemble the first in quality though they may differ from it in chemical composition. This phenomenon would seem to imply that there are separate receptors in the nerve endings which respond to different smells; but the experimental results have not proved as consistent as they promised, and the hope that the study of olfactory fatigue would provide the basis for a scientific classification of smells has not yet been satisfactorily fulfilled. Olfactory fatigue may account for the faintness of the scent of a bunch of violets when we bury our nose in it, and it may explain, in part, the unpopularity of musk as a perfume; since those who use it become so quickly fatigued that they use it to excess and become insensible to the effect that they are producing.

The personal associations that are bound up with scents are notoriously vivid, and for every one of us there are certain scents or smells that instantly recall, often with hallucinatory clearness, some past experience. The experience is always one charged with emotion, usually pleasantly toned, and when we examine the process of recall we find that the emotion comes back first and is followed, as a rule almost instantly, by the memory picture. Occasionally it takes some time to recollect the experience with which the scent is associated; sometimes, especially if the experience were unpleasant, it eludes us

altogether, and we are left with a vague feeling which we may not even associate with the scent that evoked it and may find altogether inexplicable.

This is a characteristic quality of scent, that the feeling it evokes is strong, even poignant, while the sensory impression is vague, elusive, and difficult to describe or recall. The difficulty of description is partly accidental and depends, like the Italian peasant's difficulty in describing colours (see Norman Douglas's "Old Calabria"), upon a poverty of vocabulary, due to lack of interest and discrimination. Two perfumers can describe scents to one another with a fair exactness, since they have created a vocabulary of smells by analogy, as the world in general has done for colours. But there always remains this difficulty, that a scent is often a compound of more elements than are contained in the mixed colours like mauve, orange, etc., and the components may blend so smoothly that even a skilled and experienced perfumer may find it difficult to distinguish them.

The writer may here confess, before meeting the difficulty, that he has no claim to such special skill or experience, and apologises in advance for those inadequacies of description that must inevitably occur.

The strength of feeling and the vagueness of impression evoked by a scent become more understandable when we remember that the appreciation of all beauty arose, in the dark beginnings of man, out of the stirring of the mating instinct. The beauty of form, colour and sound has developed an in-

tellectualised æstheticism, so that the connection between a work of art and the song of the nightingale or the plumage of the peacock is no longer perceptible except by inference. But the olfactory impressions have not been built up into an art, and we appreciate the beauty of a scent as we should appreciate the song of a nightingale if we had heard no other kind of music.

The pleasure that we derive from a scent is just a little nearer to the fountain-head of all beauty than the pleasure that we have from music or from the colour or form of a flower, so that we are apt to regard it with a faint uneasiness. Yet the olfactory impressions play little or no part in the sexual life of normal man; they are more subtly appreciated by civilised than by primitive people, and they may one day form the material for an art of which we can barely imagine the form. For the present they offer a field for experience that is new to most of us, and a source of pleasure that is not to be altogether despised.

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CHAPTER II

COMPOSITION OF THE SCENT

THE scent of all flowers and most leaves is due to an essential oil, a loose term that includes any odorous volatile substance that does not dissolve easily in water, and it would cover all vegetable scent substances were it not that a few, such as the balsams, vanilla, and others, happen to be solid at ordinary temperatures.

The Attars

The essential oil of flowers is sometimes known as an attar, and for convenience this word will be used to distinguish the flower oils from the leaf oils. It was first used only of attar of roses, and is said to be derived from a Persian root meaning to smell.

Many and various scented substances are found in the essential oils, but it is impossible to group them chemically with any advantage, since there is only an occasional and limited correlation between the smell of the substance and its chemical composition; nor is the exact chemical composition of the scent of much general interest, since we do not know enough of the intimate physiology of the plant to see, except in uncertain glimpses, the meaning of the presence in leaf or flower of this or that type of chemical compound. But for the sake of clearness it may be well to give here a short summary of the chief chemical

compounds that we shall meet, prefacing it with the generalisation that all contain *carbon* and *hydrogen*, nearly all *oxygen* as well, that one or two contain *nitrogen*, and some evil-smelling ones *sulphur*. A detailed account of the chemical composition of all essential oils that have been investigated will be found in the works given in the bibliography at the end of the chapter.

Esters.—Compounds formed, on the same lines as the inorganic salts, by the combination of an acid and an alcohol. Thus vinegar (acetic acid) combines with ordinary alcohol (ethyl alcohol) to give the ester "ethyl acetate," a fruity-smelling volatile liquid that has been found in the attar of some of the magnolias.

Esters make up a large part of the flower attars, and are found in some of the more sweetly scented leaves. They seldom occur singly, but almost invariably in groups made up of closely related members of the same series.

Alcohols.—Many different alcohols occur in essential oils. Geraniol, the principal scent substance of attar of roses, and linalool (lign-aloes and many flowers) are the most important. Borneol and eucalyptol (or cineol), with a sharp camphoraceous smell, are found in many leaves. The chemical names of all alcohols end in -ol.

Acids are often not found free. Valeric and caproic acids are simple, straight-chain compounds in the acetic acid series. (Hydrocyanic acid: see *Nitrogen compounds.*)

Aldehydes.—By oxidation these become alcohols. Citral (lemon) is one of the commonest in leaves, and anisic aldehyde (hawthorn) in flowers. Their names end in -al.

Ketones.—The violet scent is, apparently, always due to a ketone (ionone in violets, irone in orris root).

Camphoraceous ketones are found in leaves. The smell of rue is due to methyl nonyl ketone. Their names end in -one.

Terpenes contain no oxygen. They are usually odourless, and are found in most essential oils and some attars (*e.g.*, attar of orange blossoms and ylang-ylang). Their names end in -ene.

Benzine Compounds.—Many of the scent substances of the essential oils contain in their molecule a closed ring of six carbon atoms, which is known as a "benzine ring." These benzine compounds are prominent in the attars of the heavy-scent flowers.

Nitrogen Compounds.—The ester methyl anthranilate, which has a characteristic scent of orange blossom, and a beautiful blue fluorescence, is found in attar of orange blossoms and some heavy-scented flowers. With a methyl group added to the acid it becomes methyl-methyl anthranilate, which is found in the oil of tangerine oranges.

Indol, which occurs among the products of putrefaction and in excreta, is found in the attar of several flowers. Methyl indol (scatol) is the active principle of civet, and probably accompanies indol.

Amines are carbon compounds of ammonia: trimethylamine and propylamine give an unpleasant fishy, ammoniacal smell to the flowers of Hawthorn

and the leaves of *Chenopodium vulvaria* and Dog's Mercury.

Hydrocyanic (prussic) acid contains only one atom of carbon, hydrogen, and nitrogen, and is the simplest scent substance found in plants.

These are the only important substances containing nitrogen which are found in the essential oils.

Sulphur Compounds are invariably evil smelling and often pungent. They are found in Onions, Garlic, Horseradish, Mustard, Watercress, etc., and give a rank smell to many crucifers.

The essential oil of flowers is invariably a complex mixture, and the delicacy of the flower scents is largely dependent on this complexity; for scented leaves, whose essential oil is much simpler, never quite achieve the characteristic delicacy of a flower scent, however sweet they may be, and the difference is clearly brought out when we compare the scent of the rose with that of the Rose-Leaf geranium.

The delicacy and softness of the flower scents is not due to haphazard complexity, but to the presence in the essential oil of substances with a similar, but not identical, scent.

Often one typical scent substance predominates, but with it are associated traces of closely related chemical compounds whose scents resemble that of the dominant substance. The effect is a shading, or rounding off, of the predominant scent; so that the scent of the pure substance may be compared with a note struck on a tuning fork, and the scent of the flower with the same note played on a violin, where

the sharpness of the note is mellowed by the associated overtones.

In the rose scent the predominant substance is *geraniol*, which smells when pure rather like rose-leaf geranium. With it are associated several substances of similar scent; one or two of them are chemically allied to *geraniol*, and probably occur as by-products in its manufacture by the plant, but others, such as phenyl ethyl alcohol, though they have a distinct rosy scent, are not related chemically to *geraniol*. The presence of these last substances gives the impression that natural selection is here operating to produce not simply a sweet scent, but a certain type of scent that we know as "rose," by assembling and developing whatever substances may be able to contribute to it. A similar impression is given by the association of hydrocyanic (prussic) acid and benzaldehyde, both of which smell of bitter almonds but are chemically unrelated, in laurel leaves, peach kernels, etc.; this combination would seem to give a maximum of warning effect with a minimum of poison.

A mixture of the rose-scented substances that we find in attar of roses gives a sweet scent, but it does not reproduce the perfume of the rose, which is dependent upon at least eight or nine other substances for its character and delicacy. These may be roughly grouped into three classes: *fruit scented*, *spicy*, and *honey scented*. Included with them are substances whose scent is intermediate between honey and rose, and between fruit and rose.

All these substances occur in very small amounts

in the ordinary attar of roses, but the presence of the fruit-scented substances is evident in many of the Hybrid Tea and Pernetiana Roses, while a warm spiciness, suggesting clove carnation, can be detected in *Rosa Brunonis*, and the honey-scented substances are probably responsible for the so-called musk scent.

Very few of the finer flower scents are built up round one note, for most of them contain several distinct scents, and we may compare them, though at the risk of straining the metaphor, to a chord or a combination of chords.

The attar of jasmine consists principally of *benzyl acetate*, shaded off with traces of the allied *benzyl formate* and *benzyl propionate*, and associated with *methyl anthranilate* and *indol*. This grouping, which is never found in leaves, is typical of many heavy-scented flowers; but in Jasmine it is lightened by the presence of certain fruit-scented substances, and this combination, which we meet also in Lily of the Valley and *Daphne indica*, gives us a very exquisite type of scent. But there is a great deal more in Jasmine than this; some balsamic substance gives it a peculiar richness, and something, as yet unidentified, its individual character.

In Mimosa (*Acacia Farnesiana*, the *cassie* of the French perfumers) two principal notes can be detected, hawthorn and violet; and the scent does not seem to be so intimately blended nor so complex as rose and jasmine.

The Violet itself gives the quite different impression of a single, delicately sweet substance shading off,

through something resembling cedar wood and only faintly sweet, into a ferny, mossy scent.

Another type is found in the Wallflower, which seems to contain most of the typical flower scents; for the elements of violet, rose, hawthorn, and orange blossom have all been isolated from its attar. The violet element appears more clearly in the double wallflower, *Harpur Crewe*, which smells of mignonette.

These five types of flower scent—rose, jasmine, mimosa, violet, and wallflower—have been chosen to illustrate some of the ways in which the general effect of the scent is produced. But there are many other different modes of combination, the nature of which we can only guess by the impression they produce, since the difficulty and expense of obtaining sufficient attar for chemical analysis prevents an exact knowledge of their composition.

The essential oil of a sufficient number of flowers has been examined to enable us to draw the general conclusion that in most flowers, with the exception of the rose and violet group, the predominating scent substances are *esters*.

Alcohols predominate in the rose group, and the scent of the violet group is due, probably without exception, to ketones, ionone in the violet, irone in orris root.

Very few compounds containing nitrogen are found in the essential oils; anthranilic acid and indol occur, always together, in many of the heavy-scented flowers, and trimethylamine and propylamine contribute a stale, fishy smell to the flowers of the haw-

thorn group. The fœtor of the carrion cactus and some tropical aroids is probably due to a mixture of amines and indol.

Although esters, alcohols, or ketones may predominate in an essential oil, they are usually accompanied (except in some of the simpler leaf oils) by other and various chemical substances, so that one essential oil may contain not only esters, alcohols, and ketones, but aldehydes, phenols, cresols, and other substances.

The Essential Oil of Leaves

The essential oil of leaves is almost always simpler in composition than the attar of flowers, and it may contain only a single active substance. Thus oil of wintergreen consists entirely of *methyl salicylate*, and the scent of woodruff and Tonka bean is due to *coumarin* alone.

The essential oil of leaves, roots, etc., differs from the attar of the flowers in containing, as a rule, a fair quantity of *terpenes*, which have little or no scent, and often annoy the perfumer by suffering undesirable chemical changes on keeping or heating. They are very abundant in the citrus fruits, and it is owing to their instability that lemonade is so completely spoiled when it is made with boiling water.

Many of the typical components of the flower oils occur in leaves, and, in general, the sweeter the leaf the more nearly does the composition of its essential oil resemble that of a flower oil.

This is notable in the Rose-Leaf Geranium (*Pelargonium capitatum*), which contains *geraniol* and

phenyl ethyl alcohol, the principal constituents of attar of roses.

Most fragrant leaves contain substances which do not occur in flowers, and give the rough, sometimes pungent quality that we value in the scent of leaves. The chief of these are *borneol acetate*, *camphor*, and *eucalyptol*. Of these, *borneol acetate* occurs in the leaves of many conifers, in Rosemary and other plants; *camphor* in the Camphor Laurel and presumably in the "Camphor Plant" (*Chrysanthemum sp.*) of old cottage gardens; while *eucalyptol*, which is the chief constituent of the eucalyptus oil of the druggist, gives the characteristic herby scent to Yarrow, Lavender Cotton, Wormwood, etc.

Borneol acetate, with its refreshing scent of pine needles, is very pleasant by itself, but *camphor* and *eucalyptol* are pleasanter when they are softened and sweetened by some constituent of the flower oils; and in a typical sweet-scented leaf, such as Bay, we find a background of eucalyptol, sweetened by a rose and lily scent, and suffused with a warm spiciness by a clove element.

The leaf scents make up for what they lack in sweetness and delicacy by their sharp, refreshing character, a quality that is very marked in the many lemon-scented plants. The lemon scent, wherever it occurs, is due to *citral*. This substance is closely related to *geraniol*, and the two are often found together. We meet it almost pure in Lemon Grass (*Cymbopogon citratus*), sweetened with rose in Lemon Verbena, softened with an orange blossom element in the fruit of the Lemon and

Lime, and combined with eucalyptol in Lemon Thyme.

Geraniol, the chief component of attar of roses, is rather more widely distributed in leaves, woods, and roots than it is in flowers, occurring in a species of Lemon Grass (*Cymbopogon Martini*); in many of the Australian Pines (*Callitris intratropica* and other species), whose essential oil sometimes contains as much as 94 per cent. of geraniol; in the Bois de Rose (*Ocotea caudata*); in the Rose-Leaf Geranium, etc.

Violet-scented ketones are found in Orris root and the root of Khus-khus (*Vetivera zizanoides*), used in India for sun blinds, which are damped in the hot weather and perfume and cool the air which blows through them.

The pot herbs Thyme and Parsley owe their scent to peculiar and characteristic alcohols; the warm quality of Sage to a camphor, which is combined with eucalyptol and a pine-needle element. The characteristic cooling quality of Mint and Peppermint is due to *menthol*.

The spices may be grouped round cloves (*eugenol*), cinnamon (*cinnamic alcohol*), and aniseed (*anethol*), and these alcohols, alone or in combination, nearly always occur wherever we find a spicy scent, whether in flower, leaf, or root.

The sweet-scented balsams come between the spices and the flower attars, both in scent and composition. *Cinnamic alcohol* occurs in Styrax and balsam of Peru and in the Hyacinth; *benzyl benzoate* in balsam of Tolu and in the Tuberose; vanilla in balsam of Peru and many flowers.

Lavender may properly be considered among the leaves, since its scent comes from the leafy calyx and not from the petals. The oil is made up of the bergamot-scented ester *linalyl acetate*, softened with a trace of rose and combined with the hot and harsh eucalyptol, and the French oil is valued according to its richness in linalyl acetate. This is simple enough, but English lavender has a much sweeter and more flowery scent than the plant growing in its native, sun-baked hills round the Mediterranean, and English lavender oil commands, in consequence, a far higher price than any other. But it is poorer in linalyl acetate, and no one seems to know, or at least no one has made public, the factors upon which its excellence depends.

A number of plants contain sulphur compounds, which invariably have an unpleasant smell and never occur in flowers. They are found in Onion, Garlic, and Assafœtida; and in many crucifers, such as Mustard, Watercress, Celery, Cabbage, etc.

Certain fatty acids are common to plants and animals. *Valeric acid* is found in perspiration and in Valerian and in the bark of Elder and *Viburnum opulus;* while the goaty-smelling caproic acid is to be suspected in *Hypericum hircinum.* These fatty acids form one of the links between the scents of animals and plants.

In addition to the typical constituents of essential oils that we have mentioned, there are others which are rarer or peculiar. *Methyl nonyl ketone* is limited to Rue and a few other plants; *heptane,* a typical constituent of the mineral oils, occurs in traces in

certain conifers, but so abundantly in *Pittosporum resiniferum*, the "Petroleum Nut" of the Philippines, that the whole shrub smells of paraffin and the green berries can be lit with a match.

The active principle of one or two essential oils has eluded analysis. Oil of Patchouli is known to contain about 80 per cent. of more or less odourless terpenes, but the substance to which its peculiar and intense scent is due does not seem to have been isolated. The scent substance of animal musk is probably a ketone, but little more is known about it, and the same obscurity extends to the musk and honey scented plants, though *farnesol*, which is said to smell of lilies and cedar wood, has been found in Ambrette seed (*Hibiscus Abelmoschus*) and lime flowers, and may contribute to those elusive scents that range from musk to ambergris and beeswax.

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CHAPTER III

THE ORIGIN AND DEVELOPMENT OF THE SCENT

THE scent substances have, almost certainly, been developed out of the waste products of the plant's metabolism; that is to say, they occurred first among those end-products and by-product's of the plant's chemistry which are ordinarily thrown out as excreta. But the living organism shows an ingenious economy in making the utmost use of the material at its disposal and, very early in the history of plants, natural selection ensured the retention of the scented substances among these by-products and began to control their distribution and development according to the various functions that they were able to serve.

Several substances that occur in essential oils, such as *phenyl ethyl alcohol, indol, trimethylamine, ethyl butyrate,* etc., are known to occur among the products of the decomposition of albuminous material, either as end-products or by the recombination of these end-products with one another. Some, if not all, of the animal scents have also a similar origin; *methyl indol* (*skatol*), the active principle of civet, is a well-known excretory product, and there is some evidence to show that musk is related to the products of the breakdown of albuminous material.

The recombination along definite lines of the by-products of the plant's metabolism is probably

an important process in the elaboration of the specialised essential oils. Charabot has traced the development of the essential oil in Lavender and shown how the faintly scented *linalol* in the unripe buds combines with *acetic acid* to give the strongly bergamot-scented *linalyl acetate* of the ripe inflorescence. This in turn, by losing water, becomes *geraniol*, which adds softness to the scent and itself, by polymerisation, gives rise to *nerol*, and by recombining with acetic acid to *geranyl acetate*, both of which act as " overtones " to the geraniol.

Many of the least flowery essential oils, such as turpentine, are distributed throughout the plant, and this we may take to be a primitive condition. In the Labiates the oil is found throughout the green parts of the plant, and in some—*e.g.*, Peppermint and Sweet Basil (*Ocymum basilicum*)—Charabot has shown that it is concentrated in the inflorescence just before the flowers open. The same mobilisation of the essential oil takes place in the Rose-Leaf Geranium, with this addition, that the essential oil acquires a more flowery character as the buds open by the oxidation of the lemon-scented *citral* into *geraniol*. It may be noted that the petals of the Pelargonium and of all Labiates are scentless, while the leaves are almost universally fragrant.

A further stage in the development of the flower scent may perhaps be found in those whose leaves and petals are both scented, such as the lemon and orange family, *Magnolia Kobus*, and *Chimonanthus fragrans*. For in these the flower scent can be recognised as an elaboration of the leaf scent, along the

same lines but into something sweeter and more delicate.

Most of the highly specialised scents, such as those of the night-blooming flowers, are found in plants with scentless leaves, and perhaps the highest specialisation of all is found, as might be expected, in some of the orchids, where the stigmatic surface has a different scent from the rest of the flower. Some of the orchids show the elaborate specialisation of their flowers by giving off different scents by day and night. *Dendrobium glumaceum* is said to smell of Heliotrope in the morning and Lilac at night; *Phalœnopsis Schilleriana*, Lily of the Valley in the morning and Rose in the evening; *Pilumna fragrans*, Vanilla in the morning, Narcissus in the evening; *Cattleya Bogotensis*, Carnation in the morning and Primroses in the evening. (See D. McDonald, "Sweet-Scented Flowers," and H. H. Warner, "Scent and its Influence on Plant Life," in *Gardening Illustrated*, February, 1924.)

Our native Pyramidal Orchid has a carnation type of scent during the day, but adds a foxy smell at night. These changes in scent may possibly be due to an increase in the strength of the scent at night, for the quality of the scent is apt, as we have seen, to be altered by dilution. The faint lemony fragrance that lingers about the flowers of the Double Rocket by day is probably a portion of the full evening scent, which is like a stock.

Mr. N. G. Hadden tells the writer that the cat smell of *Orchis mascula* only develops out of the ordinary vanilla scent as the flowers fade, and it

would be interesting to know whether the scent changes when the flower is fertilised, for, if it does, it might indicate that the cat smell has some protective or warning value, since the flower discards, as a rule, all its attractive devices as soon as fertilisation is accomplished and its purpose achieved.

The simplest, if not the most primitive, production of scented substances by the plant may be studied in the bacteria. Many of these break down the material upon which they live, and are responsible for the unpleasant smells of decomposition. But, under laboratory conditions, the process of breakdown may be watched in its early stages, during which the first products of decomposition tend to combine with one another and produce sweet scent substances smelling usually of fruit, such as pineapple, strawberry, apple, melon, etc. As the process of putrefaction proceeds, these sweeter-scented compounds tend to be broken down into simpler substances, which are usually evil smelling. Since this kind of decomposition occurs also within the living organism, it is reasonable to suppose that the plant isolates these products of decomposition at their intermediate, sweet-smelling stage, and employs them for a definite biological purpose; occasionally allowing the decomposition to proceed farther when unpleasant-smelling substances, such as indol and trimethylamine, are required.

It is possible that the sweetness of the first products of decomposition may play a part in the fragrance that has been recorded of the bodies of saints and anchorites immediately after death.

Most of the bacteria which produce scent live upon albuminous material, and their activities have been made the subject of a special study by Omelianski, of Leningrad (*Journal of Bacteriology*, America, vol. iii., p. 393).

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CHAPTER IV

THE DISTRIBUTION OF THE ESSENTIAL OIL IN THE PLANT

THE essential oils are never present in a free state within the living cell, but are secreted into woody vessels, or stored either in cells from which the protoplasm has disappeared, or in specially formed capsules. These capsules may be easily seen in the skin of an orange or in the leaf of a St. John's Wort. In some plants the cells shrink apart to form a storage cavity, in others the cells themselves disintegrate, but most often the two processes take place together. It is perhaps only a parallel that the breakdown of a cluster of cells to form a cavity containing secretion is the mode of origin of the lanoline glands in the skin of animals, and that these glands produce scent as a subsidiary function.

The essential oil is stored in many different forms of container. In those leaves which are "fast of their smell," such as Bay, Myrtle, etc., the globule of oil is enclosed in a relatively thick capsule embedded in the leaf. In Thyme and many other Labiates, which give off their scent at a touch or under a hot sun, the oil is stored on the surface of the leaf in flask- or goblet-shaped cells, which are easily broken. In the genus Cistus, the oil is secreted on to the surface of the leaf, and mixed with a sticky resin to retard evaporation.

A more complicated mechanism is found in the leaves of the Rue and a few other plants. Here the oil is contained in a cavity just beneath the surface of the leaf, and roofed by a single layer of cells which is pierced by a narrow opening in the middle. The, cells of the roof, unlike those of the cuticle generally, are not dead, but are capable of swelling up and becoming turgid. When this occurs they bend inwards, enlarging the orifice and pressing on the essential oil beneath, which is thereby driven out on to the surface of the leaf. Unfortunately, we do not know what conditions bring about the movement and the extrusion of the oil.

The essential oil of the flower is contained in epidermal cells in the petal (or in the sepals, bracts, etc., which may be acting as petals), and usually on the upper surface. It is not secreted by the nectaries, except in so far as they may be part of the petal, nor is it found in the anthers, which seem to have been regarded in time past, especially by poets, as the source of the scent, as we find in Bishop Gavin Douglas's poem on the Garden of Flora, where the Damask rose " casts fragrant smell amid fra golden graines." In flowers with many stamens, such as the Rose and Welsh Poppy (faint scent of pear drops), the anthers absorb some of the scent given off by the petals, and they may serve to prevent it from being dissipated too quickly. From the work of von Frisch it seems likely that the scent of the pollen brought home to the hive by the worker bees announces to the other collectors that such or such pollen-bearing flowers are open in the

neighbourhood, and stimulates them to seek them out.

Though the stamens have no sweet scent of their own, they will be found, in the Rose and Welsh Poppy, if they are allowed to develop after the petals have been stripped from the bud, to have a faint "green" smell, suggesting cucumber; and it is possible that this may contribute a cool, leafy quality to the scent of the flower.

Since the scent of the flower is produced from the petals, there is a relation between the mass of petal substance and the strength of the scent, and we find that many powerfully scented flowers have thick, waxy petals. On the other hand, thin, flimsy petals are not well adapted for the production of scent, since their large surface area causes the essential oil to evaporate rapidly, and they can hardly store sufficient to last out the life of the flower. Yet, in spite of this disadvantage, we find a sweet scent, recalling magnolia, in *Romneya Coulteri*, the Evening Primrose, and a few other large and evanescent flowers. The scent of a flower naturally gains in strength by the doubling of its petals, as we have found to our advantage in the Rose, and the fragrance of double flowers deserves to be remembered in their favour, for an increase in the strength of the scent often brings out qualities in it that were imperceptible in the single flower.

The essential oil exists ready formed in the mature flower bud, and is not brought into it from the body of the plant at the moment of opening, but if the bud be opened before its time and the petals spread out,

they give off little or no scent, even in a damp atmosphere under a bell glass. The essential oil must, therefore, exist in the petals in an inert form, and it is almost certain that it is stored as a *glucoside*—a combination of sugar and essential oil which can be unlocked only by the action of a ferment which is present in the living cells of the plant.

Many essential oils are known to exist in glucoside form; the prussic acid and benzaldehyde of bitter almonds and laurel leaves are only set free from their combination with sugar by the action of a specific ferment, *amygdalase*, which does not come into contact with the glucoside until the plant cells are broken or bruised. Glucosides have not been demonstrated in the flower, but their presence there may be inferred from two facts; in the root of the Cowslip two glucosides have been found, of which one yields an essential oil smelling of aniseed, and the other an oil smelling of wintergreen; together they give the scent of the flower. The petals of Jasmine and Tuberose contain very little essential oil, but they continue to give off an essential oil so long as they remain alive, and the actual amount produced by the flower during its lifetime is fairly considerable. The decomposition of the glucoside is probably a reversible action; that is to say, it is brought to a standstill if the product of the reaction (the essential oil) accumulates, and it proceeds more rapidly as the essential oil is removed. This would ensure that the essential oil is not given off when the flower closes for the night or during dull weather.

The successive opening and closing of flowers is

probably determined by temperature. De Virville and Obaton (*Acad. des Sciences*, 1922, p. 841) found that the flowers of the night-blooming Campion, *Lychnis dioica*, open as soon as the temperature falls below 17° C., even in the full sunlight, and that the pink Centaury, *Erythræa centaurum*, opens as soon as the temperature rises above 19° C., whatever the conditions of light and humidity may be.

The mechanism of opening and closing is apparently determined by differential growth, and therefore ceases when the flowers are full grown.

Most night-blooming flowers remain open for one night only, and fade in the morning; but a few, such as *Gladiolus tristis*, remain open during the day, though they only give out their scent in the evening. The factors that control the production of scent in these flowers are still unknown, but some experiments are being carried out at the time of writing.

The dampness of the air seems to affect the diffusion of scent, and perhaps its production by the plant, for it is well known that the scent of Sweet Briar is most noticeable in the neighbourhood of the plant after a shower, while a few days of very dry, hot weather will take the scent out of most flowers. The phenomenon is not limited to the living plant, for Orris root and Khus-khus both give out more scent when the air is near its saturation-point with water vapour than when it is relatively dry.

It is usually said that damp air carries more scent than dry air, but this is hardly in accord with ordinary physical laws of the diffusion of gases, which the vapour of the essential oils otherwise obeys, and it is

more likely that the damp air acts mechanically on the material enclosing the scented substance, causing it to swell by the absorption of water and liberate the scent by its change of form. Sudden drying, an opposite process which also causes a change of form, tends to liberate the scent, as we may notice in a flower that is fading for want of water.

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CHAPTER V

THE FUNCTION OF SCENT

THE essential oils had their beginning, as we have already seen, in the waste products of the plant's economy, and in some plants they seem to be still at this level. In Woodruff (*Asperula odorata*) the scent only appears when the leaf is withered, and the excellent cordial smell of dying strawberry leaves is familiar, at least in quotation (the garden hybrids of the Chilean Strawberry do not seem to have it, but it may always be found in the wild Strawberry, which was the plant of which Bacon was writing). In Orris root, Valerian, Patchouli, Oak-moss (the lichen *Evernia prunastri*), and many others, the scent is set free only after the death of the plant, and we may consider these scents as most probably the chance attributes of certain waste products, with the reservation that our ignorance of a function for them does not necessarily preclude one.

Waste products are not only useless to the living cell, but almost invariably poisonous to it; this quality explains why the essential oils are stored out of contact with the living protoplasm, and prepares us to find that they have an antiseptic action, for a chemical compound that is poisonous to one form of life is usually poisonous to all, and the bacteria are very susceptible to poisoning, since they have pur-

chased their great rapidity of growth at the cost of a very thin covering to their protoplasm.

Plants seem to have exploited the antiseptic value of the essential oils at an early stage of their evolution, for it is well shown in the conifers, which exude a balsam into their wounds that seals the breach against invading micro-organisms and kills, by its antiseptic action, any that may have entered. Our ancestors imitated this process and invented the first antiseptic dressing by pouring balsams into their own wounds, and the old "Friar's Balsam" (an alcoholic solution of gum benzoin and balsam of Peru) still finds a place in the Pharmacopœia. The antiseptic power is stronger in the leaf oils than in the flower attars, which have been developed along special lines, and so, perhaps, lost some of their primitive antiseptic qualities. Eucalyptol, which occurs in nearly all scented leaves, is a powerful antiseptic, and is closely followed by oil of Thyme, Verbena, Cloves, and several others.

Taking the antiseptic value of carbolic acid as 1·0, the following values have been found for the essential oils:

Natural Oils.		*Synthetic Oils.*	
Thyme	12·2	Citral	18·8
Verbena	9·2	Eugenol (clove) ..	14·4
Clove	8·5	Geraniol (rose) ..	11·5
Cinnamon	7·8	Benzyl acetate ..	3·0
Rose	7·0	Methyl anthranilate	2·8
Rue	6·4		
Rosemary	5·2		
Lavender	4·4		
Ylang-ylang ..	2·8		

(From the *Perfumery and Essential Oil Record*, July, 1924.)

Attar of roses is more soluble in water than the other essential oils, and this advantage probably gives it a higher place in the list than it would otherwise obtain. It will be seen that the artificially prepared essential oils retain the antiseptic power of the natural ones, and, owing to their purity, show it in a higher degree.

Their antiseptic value faintly justified the use of Rue and Rosemary at the Old Bailey as protection against jail fever, and of the cinnamon and camphor in the doctor's gold-headed cane. "Four Thieves' Vinegar" was an infusion of aromatic herbs and Garlic used by four robbers to protect themselves while they stripped the dead during the plague year at Marseilles in 1722, unless it is identical with the popular vinegar invented by Mr. Richard Forthave, apothecary, of Bishopsgate Street, about the same time (but see W. T. Fernie, "Herbal Simples," p. 199).

It may well be that these prophylactics had a real value, not in destroying germs, but in keeping off the bugs and lice that carried them. The black plague and the purple fever have withdrawn to less civilised countries than ours, together with their attendant vermin, and the sprigs of Rue and Rosemary only persist at the Old Bailey out of our pleasant respect for old tradition. But the vermin reappeared with the relapse of civilisation in the Great War, and were proven carriers of trench fever; and once again the essential oils were used to ward them off. The writer remembers very well, one damp December night during the war, stumbling across

a powerful scent of mixed aromatics in Sanctuary Wood and finally tracing it to a yeoman who had protected himself against lice by saturating his clothes with a mixture of aniseed and sassafras.

The plants also use essential oils as a protection against insects, and we may suppose that the pungency of their resin played a part in protecting the conifers from the leaf-eating beetles of the carboniferous period, just as the essential oil of the Australian pines wards off the attacks of ants to-day. Yet the protective value of the essential oil against insects is less than might be expected, for the youngest shoots, which are most vulnerable, are poorest in essential oil, and we know that, in the garden at least, slugs will eat the leaves of Monarda, Lemon Verbena, Mint, and other aromatic plants. But plants seem to adapt their defences against their most troublesome natural enemies, rather than to aim at a general protection, and it is not safe to draw conclusions from their vulnerability under garden conditions.

The essential oils seem to be a more effective protection against browsing animals, who dislike the hot, burning taste of most of the leaf oils; and the goats, who have denuded so much of the Mediterranean basin, spare the aromatic plants of the *maquis*. It may be noted that plants which are already protected against browsing animals by thorns very rarely possess any essential oil.

It has been observed that among the plants which are adapted to life in hot, dry situations a very large number of species are scented. The low scrub of

the dry foot-hills round the Mediterranean, the *maquis* already mentioned, is largely composed of Lavender, Rosemary, Myrtle, Bay, Cistus, Sage, Thyme, and various small aromatic Labiates, which give off an unforgettable scent under the hot sun. The function of the essential oil in these plants is rather obscure, but most probably the atmosphere of essential oil vapour, by which each plant is surrounded, acts as a blanket to protect it from being scorched by the sun and from a too rapid change of temperature, since it has been shown that such vapour offers a greater resistance than air to the passage of radiant heat. It has been suggested that this blanket also checks the diffusion of water vapour, and enables the plant to economise its water-supply, but the evidence on this point is conflicting. These plants of the dry countries often protect themselves against the heat by a covering of woolly hairs, much as the Bedouin does with his thick burnous, and therefore we find that many grey-leafed plants are strongly scented.

The scarcity of vegetation in dry and sunburnt regions exposes the plants that succeed in growing there to more persistent attacks from browsing animals than elsewhere, and this extra need for protection would enhance the value of a pungent essential oil and may be another factor that determines the frequent occurrence of aromatic species among xerophytic plants.

A few plants, such as *Crucianella stylosa*, the Crown Imperial, *Codonopsis spp.*, and some of the Azaleas, have an unmistakably foxy smell, which

might be expected to scare herbivorous animals and protect the plant from them, but the only experiments that the writer was able to make were inconclusive, for young calves were found to eat the leaves of Crucianella, though they refused the Crown Imperial. The Codonopsis usually inhabits thick woods, where it would scarcely be exposed to the attacks of browsing animals; so that it is very unsafe to conclude that these animal smells have a protective function, although it is difficult to believe that a powerful scent, perceptible five or ten yards away from the plant, is merely accidental.

The most specialised function of scent is not to repel but to attract. It reaches its highest development in the flower, but it appears already among the fungi, notably in the Stink Horn (*Phallus impudicus*), whose horrible fœtor, which can be smelt ten or twelve yards away, attracts blowflies in large numbers. These feed on the foul-smelling slime with which the cap of the fungus is covered, and carry away with them and disseminate the spores that are embedded in it.

The flower (in the ordinary sense of a conspicuous flower) is a mechanism called into being by the nectar-feeding insects which fertilise it. The colour, form, and scent of the flower are adapted to the one end of attracting or guiding the insects that visit it for the plant's purpose of securing cross fertilisation, and flowers do not occur except in association with these insects. The earth was flowerless until the bees and butterflies appeared, and to-day, where there are few nectar or

pollen eating insects there are few conspicuous flowers.

In some plants, such as Peppermint, Basil, and Rose Geranium, the essential oil is concentrated in the leafy parts of the inflorescence, and may become more flowery in character as the buds open. In these plants the flowers themselves are scentless, and it would be reasonable to suppose that the scented leaves are here acting as guides to the visiting insects, in the same way as the scented leafy calyx of the Lavender presumably does. But Charabot and Laloue, who investigated this transference and change of the essential oil and found that the oil is used up in the inflorescence, conclude that it is employed as a food material, though the evidence in favour of their theory hardly seems strong enough to support it.

As the scent of the flower is determined by the insects that visit it, the relation between the insects and the scent deserves particular attention, and is therefore dealt with in a chapter by itself (see Chapter VI.). We may therefore leave the function of the scent in securing cross fertilisation, and pass on to the use made of scents by the higher plants in furthering the dissemination of their seeds. This is particularly well shown in the orange, which is protectively coloured and only faintly scented till the seeds are ripe, when it becomes conspicuous and its essential oil develops a sweet, flowery quality. The whole mechanism of the orange is remarkably co-ordinated for its purpose, the essential oil, though attractive to the nose, has a hot, burning taste,

which deters gnawing insects and makes the sweet pulp available only to those birds and animals which can tear the fruit to pieces and scatter the bitter seeds, which, by their shape and slipperiness, are beautifully adapted to be flipped or spat away to a distance. The attractive function of the essential oil appears in most fruits, in the popular sense of the word, and man has not neglected his olfactory sense in developing their flavour by hybridisation and selection.

CHAPTER VI

INSECTS AND THE SCENT OF FLOWERS

THE scent of the flower is adapted, often very closely, to the insects which most commonly visit it. The Carrion Cactus (*Stapelia*) not only looks but smells like carrion, and is visited by carrion flies, which seek it out from a long distance, and bluebottles have been known even to lay their eggs on its leathery petals as they do on the foul-smelling *Amorphophallus*. It is always the flies, the "stupid flies" as Fritz Müller calls them, who are taken in, and they may be seen patiently licking the livid blue spots on the fly orchid, which they appear to take for decomposing flesh, and the varnished knobs of imitation nectar with which the Grass of Parnassus cheats its visitors.

Besides the few foul-smelling flowers there is another large group of flowers which are adapted to attract flies. To this group, whose flowers have a stale scent that often suggests the sickly sweetness of early putrefaction, belong the Hawthorn, Rowan, Pear, and many of the Umbelliferæ.

To many people the flowers of the Hawthorn, especially in mass, have a distinctly fishy smell, a comparison that is chemically exact, since they contain *trimethylamine*, a substance that is found in large amounts in herring brine. It also occurs among the first products of putrefaction, and the superstition

that to bring hawthorn flowers into the house is unlucky and portends a death may perhaps depend upon an unconscious olfactory association. Walter de la Mare shows the sensitive perception of an artist when he says that "the Hawthorn hath a deathly smell."

In the last two groups the function of the scent is to attract the flies, but when we come to the flowers fertilised by bees, we find the scent playing a slightly different rôle. Here it is not attractive in itself, but serves partly as a guide to the flower, and partly, it would seem, as a distinguishing mark to enable the bee to recognise the flower more surely and adhere to its "flower faithfulness" in visiting one species of plant only, a habit that is of the greatest value to the plant in ensuring effective fertilisation. von Frisch has shown that scent is secondary to colour in guiding the bees, but his latest experiments seem to show that the bees have exploited the scent of flowers for a special purpose of their own. He observed that when a worker bee returns to the hive after visiting a flower well provided with nectar, she executes a kind of dance which attracts the other workers, who gather round and palpate her with their antennæ; these immediately leave the hive and fly to the flowers of the species that she has visited. If the messenger bee has been fed with syrup scented with peppermint, the bees who have been attracted to her fly off and visit anything scented with peppermint that has been placed in the neighbourhood of the hive. The scent here seems to convey a message that such or such a flower is providing nectar within range of the hive.

In a long series of careful experiments von Frisch has found that the bees' appreciation of scent is very much the same as our own. They perceive the same smells that we do, and with about the same acuity; they also fail to discriminate between those scents which we ourselves find difficult to distinguish. He did not find any flowers that were odourless to ourselves but scented to the bees.

Since scent is a secondary consideration for the bee, we do not find it highly developed in the flowers which are specially adapted for fertilisation by them. Such flowers are the Labiatæ, Papilionaceæ, and Scrophulariaceæ. In the labiates the flowers are scentless, and the plant uses a temporary concentration, and sometimes a slight elaboration of the leaf oil, to give the general inflorescence a rough scent. The Papilionaceæ are either scentless or (with the exception of a few such as the Sweet Pea and Broad Bean) have a scent which is but slightly specialised, and is often like honey. The Scrophulariaceæ are almost invariably scentless.

When we come to the flowers which are fertilised by moths and butterflies, we find that they include almost all the very sweetly scented flowers, Jasmine, Hyacinth, Honeysuckle, Tuberose, Narcissus, etc. In these the scent is highly specialised, and its function is not only to guide, but to attract the insect visitors.

The nature of the attraction becomes clear when we find that many of the moths and butterflies are sweetly scented, that the scent is limited to one sex, and plays a part in their courtship.

The scent is different in different species, and is usually described as sweet, and often as flowery. Vanilla seems to be the commonest scent, while some species are described as smelling like Jasmine, Syringa (*Philadelphus*), Honeysuckle, Convolvulus, etc.

The scent is due to an essential oil which can be extracted with alcohol, and is secreted at the base of special tufts of scales or plumy hairs. These are lightly coated with a greasy substance which fixes the scent as it spreads up into them, for they lie, as a rule, folded down into a groove at the posterior margin of the wings and are only everted during mating, when they act as very efficient distributors of perfume, owing to the large area which they expose to evaporation. In some species (the *Erebid* moths) the scent hairs lie concealed in a groove on the front leg until the limb is over-extended, when they appear as relatively enormous plumes. In other species the scent organ is an extrusible tuft of hairs lodged at the end of the abdomen, and with this *Amauris niavius* has been observed assiduously stroking the patches of scent scales on its wings, apparently in order to endue it with the perfume (W. E. Lamborn, *Proc. Eng. Entom. Soc.*, 1911).

The scent organs have long been known to morphologists, but their function was unregarded until, in 1877, Fritz Müller, a German naturalist in Brazil, drew attention to the scent of butterflies, and recognised it as a secondary sexual character. He also noted that there seemed to be a connection between the colour and the scent of butterflies and that of

the flowers they visited. The subject does not seem to have received any further attention until about 1905, when Colonel Longstaffe and Dr. Dixey began to note the scent of the butterflies that they collected, and described various forms of scent organ. Colonel Longstaffe, in his book "Butterfly Hunting in Many Lands," describes the scent of more than 120 species, and gives in an appendix a translation of several of Müller's papers.

The function of the scent in butterflies was clearly established by Dr. Carpenter (*Proc. Eng. Entom. Soc.*, 1914), who was able to watch the mating of one of the African butterflies, and observed the male hovering over the female, alternately protruding and withdrawing its plumy and conspicuous scent brush, and apparently scattering over her a perfumed dust composed of the débris of the scent scales.

The scent of butterflies has been described at some length in order to show how highly the function has been developed in them; for, since the flower has been evolved entirely in relation with the insects that visit it, we must conclude that had it not been for the scent of the butterflies we should have had no fragrant flowers.

The butterflies have been called the flowers of the air, but in biological fact the flowers are the butterflies of the earth, impressionistic designs in scent and colour founded on the butterfly motive.

The hawk moths will fly direct to a scented flower in the dusk from a distance of a hundred yards or more, and dart from blossom to blossom with almost the busy precision of a bee. But most butterflies

show no such settled purpose, they chase their mates gaily from flower to flower, or bask for hours together on the scented blossoms in a kind of drunken cestasy.

The late Emperor of Japan seems to have caught the relationship between butterflies and flowers when he wrote, in a poem called "The Butterfly":

> Long glowing miles of flowers in bloom,
> Whose fragrant petals all enchant thee,
> Woo endlessly thy longing soul
> To flutter on from bud to blossom:
> Thou too, my dainty butterfly,
> By passion martyred, chase new beauty
> Nor ever sink to soothing sleep
> Nor wrap a childlike dream about thee.
>
> (Translated by Gonnosoke Komai, and published in the *Observer*.)

The production of scent as a secondary sexual character is not limited to butterflies, but is found also in several species of beetles, and other insects, as well as in many mammals. Sir Thomas Browne writes curiously that "we find so noble a scent in the Tulip Fly and the Goat Beetle." Howlett noticed that the males of the fruit fly *Dacus zonatus* were strongly attracted by the smell of citronella, and would almost cover a handkerchief scented with it, sitting on the scented surface and rocking to and fro in their characteristic courtship movement. He found that while the males were scentless, the females gave out a distinct scent of citronella. As these flies feed on the mango, their scent production has presumably not been exploited by the flowers for purposes of attraction, though it is easy to see how this might be brought about, since citral,

the scent substance of citronella, is found in many plants and some flowers.

The bees are said by von Frisch to have the power of producing a fruit-like scent; but they have gone farther than the butterflies in their sexual specialisation, and along different lines, so that the old function of the scent has changed, and in the sterile workers it seems to serve the purpose of spreading the information that a plentiful supply of nectar is available. For the sexless worker bee the flower has no romantic attractions, and it is sufficient that it should display a broad patch of colour and a scent of any recognisable quality. The sweetest and most highly developed scents are, therefore, found in those flowers which are specialised for fertilisation by moths and butterflies.

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CHAPTER VII

SCENT IN RELATION WITH BOTANICAL CHARACTER

PLANTS that are related botanically show, as might be expected, a rough similarity in their scent; but the scent of related species is seldom identical, since, as we have seen, one function of the scent is to act as a distinguishing mark, and to help the visiting insects to confine their attentions to one species rather than carry infertile pollen between flowers of different genera. Where two species of plant have the same flower scent, they are usually found to be widely separated geographically, as in the Chilean shrub *Azara microphylla*, and the Alpine orchid *Nigritella*, the Chinese *Berberis Bealii* and the European Lily of the Valley.

Some families are very rich in scented species. All the Labiates produce an essential oil of some kind which is often sweetly scented—Lavender, Rosemary, Balm, Mint, Thyme, Basil, Marjoram, Sage, Patchouli, etc. Nearly all the Umbelliferæ are strong smelling, and though most of them are unpleasant, they give us several spices—Carraway, Coriander, Dill, Aniseed, Fennel, Cumin, and the musk-scented Angelica; while one genus, *Ferula*, yields Assafœtida (smelling of garlic; called "Devil's Dung" by some nations, but "Cibus Deorum" by the old physicians, and used as a condiment in Persia), Sumbul (musk),

Opoponax (a peppery scent, faintly suggesting mignonette), and Galbanum. The Rutaceæ include a very large number of scented plants—the Citrus group, Myrrh, Frankincense, Mastich, Cedrela, Magnolia, Boronia, Angostura, Rue, etc.

On the whole, the variety of scent within a genus is more striking than its similarity, though we can usually detect a family likeness behind the difference. In the Berberis species there is a slightly unpleasant, rather animal scent that is most apparent in *B. vulgaris*, but seems to be common to all, and can be detected in the differing sweetness of *B. aquifolia*, *B. dulcis*, and *B. Bealii*.

In the large Iris genus, where the species differ a good deal from one another, the family likeness of their scent is barely perceptible, but a certain fresh, leafy character seems to link together the violet scent of *I. verna* and *I. reticulata*, the primrose of *I. stylosa*, the vanilla and civet of *I. pallida*, the almond of *I. persica*, and the tea-rose scent of *I. Hoogiana*.

Sometimes a genus that we look upon as characteristically scentless will produce one or two scented species; among the Columbines *Aquilegia viridiflora* has a strong, sweet scent, slightly suggesting *Daphne Mezereon*, and the flowers of *Delphinium Brunonianum*, upon which the musk deer is supposed, quite erroneously, to feed and depend for its scent, smell strongly of musk. *Aristolochia gigantea* is a fragrant species in an evil-smelling genus.

The scent of the flower is related to the colour in so far that both have the same function, but the link

between them is not very close. The percentage of scented species is highest among white-flowered plants, which come easily first with about 15 per cent.; red-flowered plants come next with about 9 per cent., fairly closely followed by yellow and purple, while very few true blue flowers are scented. The high percentage of sweet-scented white flowers is attributable to the night-blooming and crepuscular flowers, which are almost invariably white and sweetly scented. Red flowers lose their colour, to our eyes at least, in a faint light, and are among the earliest to close, as Tennyson noted when he wrote "Now sleeps the crimson petal, now the white," and they are never visited by the night-flying moths, for whom the most fragrant scents are evolved. Pure scarlet is a rare flower colour in temperate climates, and when it occurs, as it does more frequently in South America, the flowers are very often fertilised by humming-birds and sun-birds, in whose plumage bright red often predominates. Since birds make no use of their sense of smell, none of the flowers habitually fertilised by them are fragrant.

Butterflies seem to favour the reddish colours, and their preference brings up the percentage of scented red and pink flowers.

The colour sense of bees has been shown by von Frisch to be approximately the same as that of the ordinary "colour blind" person—*i.e.*, they do not distinguish red from green, and confuse these colours with grey. The bee flowers are, therefore, predominatingly purple, violet, or blue, and since scent

is of less importance to the bees than colour, we do not find very many fragrant and highly developed scents in flowers of these colours.

There are very few scented flowers of pure blue, probably because pure blue is the rarest of flower colours, and is favoured by bees (*e.g.*, *Salvia patens* and the Borage family). At first sight there seems to be a dissociation between scent and the colour blue, since the only scented campanula is the yellow *C. thyrsoides*, and the only scented gentians the dingy purple *G. pannonica* and *G. purpurea*. But perhaps here again the insect visitor is the determining factor, for two blue species of Meconopsis are known to be scented (*M. speciosa* and *M. latifolia*) and Mr. Kingdon Ward has recently discovered another (K. W., 5751). In a private communication he has very kindly added that all the fragrant species of Meconopsis have the same scent, of a light, delicate quality that faintly suggests a tea rose, and has pointed out that one of the bluest of the primulas (*P. cernua*) is sweetly scented.

Tecophilea cyanocrocus is said to be fragrant, and Kerner describes *Gentiana ciliata* as violet scented; the writer has not been able to discover any scent in either of these, but can record a powerful scent, very sweet and fruit-like, in the blue Egyptian lotus *Nymphœa stellata*.

On the whole, it seems very unlikely that there is any antagonism between scent and a pure blue colour in the flower. Owing to the rarity of the combination it is always a pleasant surprise to meet with fragrance in a blue flower, and it would be inter-

esting if the two characters could be brought together by selection and hybridisation.

The scent may be bound up with other biological characters, as Baker has shown in the many species of Eucalyptus, where he found the quality of the leaf scent to be associated with certain patterns in the veining of the leaf, so that it was possible to determine from the venation in any given species the constituents which would predominate in its essential oil.

A similar association has been found in the genus Cinnamomum, and its discovery elsewhere might be of use to the hybridist who was breeding specifically for scent.

It is doubtful whether any flowers rely entirely upon scent to attract their insect visitors, for although some flowers, such as *Azara microphylla*, the Musk orchid (*Herminium monorchis*), *Moschatella adoxa*, and others, are inconspicuous to our eyes, they may well be obvious enough to the small, short-sighted insects that live in their vicinity and habitually fertilise them.

Relation between Scent and Habitat

The scent of a flower is most effective in a warm, moist, and fairly still air, and for this reason we find a large number of scented species among the plants of woodland and deep valleys. The twilight of the woods also gives scent a relative advantage over colour as a guide to insects, and many of the woodland flowers show a certain likeness to the night-blooming flowers in their rich, heavy scents and pale

colours—*e.g.*, Lily of the Valley, *Epigæa repens*, *Pyrola uniflora*.

In the cold eddying air of the high Alps scent is less useful, and is not found very commonly among the brilliant flowers of the scree and bare rocks, though *Petrocallis pyrenaica*, *Thlaspi spp.*, and the Alpine Poppy are exceptions. The pure hawthorn scent, usually with an added sweetness, is common in the few fragrant alpines, and it may be noted that an element of bitter almond, which is often associated with hawthorn, is found in the flowers of many low-growing plants; it enters into the scent of *Convolvulus arvensis*, *Spiranthes autumnalis*, *Orchis ustulata*, *Linnæa borealis*, *Shortia galacifolia*, *Epigæa repens*, and *Oxalis enneaphylla*. It would be interesting to know whether the hawthorn and almond scents are attractive to any particular type of insect visitor.

In very dry, sunburnt regions the plants are rich in scented leaves, but rather poor in scented flowers, most of which appear in the earliest and dampest months of the year, and so give us some valuable fragrant flowers for the garden in the first days of spring—*Muscari*, *Crocus spp.*, *Iris reticulata*, etc.

Our stormy climate is less favourable to scented flowers than the hot, moist atmosphere of the tropics, but we have a few native plants—the Wood Violet, Lily of the Valley, Honeysuckle, Sweet-scented Orchid (*Gymnadenia canopsea*) and Butterfly Orchid —whose fragrance will stand comparison with the exotics.

For spices and sweet gums the Northern countries

are almost entirely dependent upon the tropics, and from our own resources we can only produce Coriander, Carraway, Aniseed, Angelica, and Dill, with a possible substitute for cloves in the root of the Water Avens (*Geum urbanum*), and the pot herbs Thyme, Mint, and Marjoram. Sweet flag (*Acorus calamus*), Sweet Sedge (*Cyperus longus*), Bog Myrtle (*Myrica gale*), and Oak Moss (*Evernia prunastri*), are almost the only native perfume material, though the root of *Sedum Rhodiola*, with its scent of rather stale rose water, might be pressed into service.

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CHAPTER VIII

CLASSIFICATION

PART I

The Classification of Flower Scents

NO really satisfactory classification of smells in general has yet been produced, for, since we do not know the chemical or physical factors which determine the quality of a smell, the classification must be made according to the impression produced upon the individual, which is profoundly influenced by personal association. In spite, therefore, of a general agreement in the subjective classifications proposed by the different workers, there are inevitable discrepancies. Thus to Zwaardemaker the smell of black currants suggests a cat, as it does to many people, and he classifies it accordingly. Henning, who appreciates black currants more highly, places the smell in quite a different category. The discrepancy here may be due to the change in quality of a smell when diluted, for the unpleasant quality of the black-currant scent is fairly apparent when pruning the bushes, while only a very sensitive nose will detect it in the fruit.

The flower scents are easier to classify than smells in general, because the number of odorous substances in the vegetable kingdom, though very large, is

limited; so that the same scent, wherever it occurs, is usually due to the same substance. We have, therefore, an objective basis of classification in the chemical composition of the essential oil. It is true that it is only a rough guide, for our knowledge of the chemistry of the essential oils is still very imperfect, but it forms a fairly definite ground plan about which to group our sensory impressions. A classification is desirable, even though it be imperfect, for it helps us to appreciate scents by enabling us to think about them in their relation to one another, to describe them, and to recall them more easily to memory.

In 1893 the Austrian botanist Count Kerner von Marilaun put forward a classification of flower scents in which they were arranged in groups according to the chemical substance that predominated in their essential oil. Comparatively little was then known of the composition of the essential oils, and the classification was admittedly tentative, but it had a particular value since some of the groups were found to be visited, almost exclusively, by certain types of insects. Slightly abridged the classification stands as follows:

Indoloid Group:
Characterised by the presence of *indol.*
Stapelia, Amorphophallus, Aristolochia, etc.
Visited by carrion flies and dung flies.

Aminoid Group:
Characterised by the presence of *trimethylamine* and *propylamine.*
Hawthorn, Pear, Sweet Chestnut, Rowan, etc.
Visited by flies.

Benzoloid Group:
Characterised by compounds containing the *benzol ring.*
All sweet-scented flowers except those in the next two groups.
Visited by bees, butterflies and moths.

Paraffinoid Group:
Characterised by open chain compounds of the *paraffin series.*
Rue, Rose, Vine flower, Lime flower, Valerian, Goat Orchid.

Turpenoid Group:
Characterised by *terpenes.*
Citrus flowers, some Magnolias.

Honey-Scented Flowers:
Unplaced.

The first three groups are very satisfactory, but the rose and vine flower are clearly incongruous in the paraffin group, in which they were included on the supposition, which has since proved to be incorrect, that their scent was due to simple, straight-chain paraffin compounds. It is therefore suggested that rose should be placed in a group by itself, and the other scents of the Paraffinoid group redistributed. The name "Turpenoid group" is no longer valid, since it is now known that the terpenes do not contribute to the scent, and it may be changed to "Lemon group." The Benzoloid group, which embraces almost all sweet-scented flowers, is inconveniently large for general purposes, and it is proposed to subdivide it into three. The modified classification would therefore be as follows:

Indoloid Group:
Quality, fœtid.
Essential oil contains *indol.*
Type flower, Stapelia.

AMINOID GROUP:
Quality, stale and slightly sweet.
Essential oil contains *trimethylamine*.
Type flower, Hawthorn.

HEAVY GROUP:
Quality, very sweet and heavy.
Essential oil contains *benzyl acetate, methyl anthranilate, indol*, etc.
Type flower, Jasmine.

AROMATIC GROUP:
Quality, sweet, with a spicy quality.
Essential oil contains *eugenol, cinnamic alcohol, vanilla*, etc.
Type flower, Clove Carnation.

VIOLET GROUP:
Quality, sweet, but less heavy than preceding groups.
Essential oil contains ketones of the *ionone* type.
Type flower, Violet.

ROSE GROUP:
Quality, sweet, not heavy.
Essential oil contains *geraniol*.
Type flower, Rose.

LEMON GROUP (Kerner's Turpenoid group):
Quality, light, fresh.
Essential oil contains *citral*.
Type flower, Magnolia grandiflora.

FRUIT-SCENTED GROUP:
Quality, fruity.
Essential oil contains esters of higher fatty alcohols.
Type flower, Philadelphus microphyllus.

ANIMAL GROUP:
Quality, animal and unpleasant.
Essential oil contains ? *caproic* and *valeric acid* and their esters.
Type flower, Lizard Orchid.

MUSK AND HONEY GROUP:
Quality, sweet, often rather dry and dusty.
Essential oil, ? *farnesol*.
Type, Musk Orchid (*Herminium monorchis*).

With this tentative and rather rough scheme of classification as a basis we may now proceed to examine the various groups in detail.

PART II

The Indoloid Group

The flowers of this group are usually blotched in livid shades of yellow and purple, and resemble carrion in appearance as well as smell. Their nectar is exposed in shallow cups of easy access to the short probosces of the carrion flies and dung flies that frequent them. Their smell may be that of decomposing animal matter (*Stapelia*), decaying fish (*Amorphophallus*), or excreta, while the North American Skunk cabbage is said to smell like a mixture of carrion, garlic, and skunk, and spiders build their webs about it to profit from the swarms of flies which it attracts. Some of the dingier coloured Fritillaries belong to this group, but these fœtid smells are chiefly produced by tropical plants belonging to the Aroid, Aristolochia, Balanophoreæ, and other groups.

Aminoid Group

The scents of this group may be more or less sweet, but all have a stale, sickly quality even when dilute, and when strong, something ammoniacal and fishy, which is due to the presence of trimethylamine and propylamine, can usually be detected in them (see p. 40). Hawthorn is perhaps the sweetest, and its pleasant quality is due to *anisic aldehyde*, which occurs, unmixed with the unpleasant-smelling amines, in several other flowers, such as the Water Hawthorn (*Aponogeton distachyon*) and several of

the few high alpines that are fragrant, *Thlaspi spp.*, *Morisia hypogœa*, and the Alpine Poppy. Since these are without the unpleasant quality that distinguishes this group, they are placed with the aromatic scents.

All the flowers of the Aminoid group have easily accessible nectar, and, as might be expected from their smell, they are eagerly visited by flies. The scent is found in many genera of the *Rosaceæ*, *Cratægus*, *Sorbus*, *Pyrus*, *Cotoneaster*, *Spirea*, *Sambucus*, *Viburnum*, etc., in many Umbelliferæ; in the Privet, Sweet Chestnut, and Henna (*Lawsonia inermis*). In Privet the scent is distinctly ammoniacal, but this quality is luckily absent from the nearly related lilacs, though for the writer there is something very faintly unpleasant, but indefinable, which detracts from their fragrance.

If the Elder flower is distilled or fermented its scent changes character and develops a very pleasant muscat quality, and a wine made from elder flowers and raisins is not unlike Muscat de Frontignac.

Heavy Group

In this group we come to the most highly developed flower scents and some of the sweetest. Yet for many people there is something a little disagreeable in their sweetness, and when very strong they are liable to become actually unpleasant; as Gerard says of the Syringa, they are "too sweet, troubling and molesting the head in a strange manner." Miss Jekyll records that the scent of a bunch of Jasmine

on a hot night in Jamaica gave rise to the suspicion of a dead rat under the floor, which is a quite logical association of seeming opposites, since indol is present in both. This substance, which is one of the typical products of the putrefaction of animal tissues, is found in the essential oil of many heavy-scented flowers, and the closely related scatol (methyl indol) is the active principle of civet. When strong its smell suggests a sewer, but on dilution the unpleasantness fades, and at very high dilutions it becomes sweet and flowery. It is not known to occur in all heavy-scented flowers, but its presence is to be suspected in *Jonquil* (whose scent is almost identical with civet), *Hemerocallis*, *Viburnum Carlesi*, *Pheasant's Eye Narcissus*, most Lilies, *Tuberose*, *Honeysuckle*, *Daphne Mezereon*, *Lilac*, *Philadelphus coronarius*, etc., and it may well be that its primitive, animal quality accounts for the heady, disturbing character of the scent of these flowers.

In most of the flowers of this group the nectar is concealed, often at the bottom of long tubes, and is accessible only to moths and butterflies, for whom the flowers are specially adapted, not only in form, but also in their time of opening, for many of them are night flowers, and are fertilised only by the night-flying moths. The adaptation is completed by the scent, which, as we have seen, has been evolved to match that of the butterflies themselves.

Most of the flowers of this heavy group give off a great deal of scent, and tend, therefore, to have thick, waxy petals; many of them are evening-scented, and are therefore white or very pale

coloured—*e.g.*, *Jasminum officinale*, *Philadelphus coronarius*, *Cestrum grandiflorum* (the *Dama de Noche* of the Philippines), Orange blossom, etc., and the "white flower scent" of some writers seems to be almost identical with this grouping.

In addition to the flowers already given, this group includes a number of woodlanders (which have a good deal in common with the twilight flowers), such as *Cyclamen Europæum*, *Epigæa repens*, *Pyrola uniflora*, *Aquilegia viridiflora*, *Daphne laureola*, *Lily of the Valley*, *Sarcococca ruscifolia*, etc.

The heavy scents are often described as "tropical," and the flowers of the damp equatorial forests (*e.g.*, many Orchids) are often heavy scented, but this type of scent is associated rather with twilight and the night-flying moths than with heat, for several flowers of our Northern woods, such as the Butterfly Orchid, Honeysuckle, and *Daphne laureola*, have a scent which could be described as "tropical" if we could detach it from its associations.

The Aromatic Group

This group shades imperceptibly into the last, and is not distinct biologically, for it also is visited chiefly by the Lepidoptera, though, on the whole, it is rather more adapted to the butterflies than the night-flying moths. Unlike the heavy group, its essential oil always contains some elements that are found in the oil of leaves and barks, such as *cinnamic compounds*, *eugenol* (cloves), *anethol* (aniseed), and *vanilla*.

The balsamic scents, such as Hyacinth and Broad

Bean flowers (with their suggestion of cinnamon), the Night-scented Stock, and the Tobacco Plant, have a rich, heavy quality, and are very near the last group.

A clove scent appears faintly in *Viburnum Carlesi* and *Gymnadenia canopsea*, which are on the borderline between the heavy and aromatic; more strongly in the double Stocks and certain Roses (see p. 99); and more fully in the *Clove Carnation*, *Dianthus spp.* and the *Clove-scented Broomrape*.

A very faint suggestion of aniseed is perceptible in the Primrose and Cowslip and is characteristic of many Primulas, though some—*e.g.*, *P. chionantha*—have a very different and sharper scent. The aniseed quality is obvious in the stem and root of the Cowslip (see p. 29) and in the leaves of *P. anisodora*.

The *vanilla scent* is common in flowers, and occurs almost pure in *Azara microphylla*, *Nigritella* (the little Orchid of the Alpine pastures), and *Clematis flammula*. The scent of bitter almonds and the pure hawthorn scent are often associated with vanilla and with one another; vanilla and almond in Cherry Pie (*Heliotropa peruviana*), almond and vanilla in the hardy annual *Schizopetalon Walkeri*, hawthorn and almond in the Flowering Rush (*Butomus umbellatus*). Bitter almond predominates in the Common Convolvulus (*C. arvensis*), the native Orchids *Spiranthes autumnalis* and *Orchis ustulata*.

Hawthorn predominates in *Aponogeton distachyon* (the Water Hawthorn), *Choisya ternata*, and several alpine crucifers. It has already been noted that

many low-growing scented plants belong to this vanilla—almond—hawthorn group.

The pure hawthorn scent is the least spicy of the aromatic group, but it is included with it because of its association with vanilla, and because it is due to *anisic aldehyde*, which is chemically related to *anethol*, the scent substance of aniseed.

The flower scents of the Aromatic group are less liable than the heavy scents to become unpleasant when they are strong, and, on the whole, they are less heady. But those that come near to the heavy group, such as the Tobacco Plant, Night-scented Stock, and Bean flower, have a disturbing effect on many people. The Bean flower is said to cause strange dreams and a kind of March madness in any one who falls asleep near a field of them in full bloom, and by homeopathy their scent is reputed to cure insanity. A mediæval rhyme says: "Cum faba florescit, stultorum copia crescit." This effect of the scent of the Bean flower is not a mere efflorescence of the popular imagination, for a correspondent who has a very acute sense of smell, sends the following vivid account of the deep emotional reaction which it can evoke: "I can remember as a girl in my twenties often bicycling in the country, and saying to my companion, 'We are coming to a bean-field.' This was sometimes as much as a mile away, when the scent was still quite faint; but the effect was always the same—an extraordinary sense of elation and joy which amounted to excitement, with quick breathing and beating heart when I was actually passing the field or close to it. The scent

of one flower had no effect—it was only when I had it in quantity, so to speak! I remember once being in the train beside the open window; I was reading, and quite absorbed in a very interesting book; presently I became aware that my heart was beating and I had my 'beanfield feeling.' I was just saying to myself, 'This book is as exciting as a beanfield,' when I looked out of the window and saw we were passing a beanfield! The effect passed off as soon as we were out of the scent zone, which proved it was not the book. It was a most delightful sensation, and the excitement pleasurable; a sort of happy, buoyant ecstasy."

The scent of the bean flower has probably gained its reputation less on account of any quality peculiar to it than because it is almost the only scent of its type which is produced in very large quantity in England. A bed of Night-scented Stock may be almost equally disturbing, but the spicier flower scents of the Aromatic group, such as Clove Carnation, do not go so deep, are much less insidious, and produce at the most a cheerful sense of well-being.

Summary of Aromatic Group

Balsamic Type:

Hyacinth. Broad Bean. Tobacco Plant. Night-scented Stock. Rose "Danäe" and "Cornelia." Many tropical Orchids—*e.g.*, *Lælia acuminata*, *Lycestis spp.*

Clove Type:

Clove Carnation and several species of Dianthus. *Rosa Brunonis.* "Irish Elegance." Double Stocks. Rocket. *Gladiolus tristis.* Clove-scented Broom-rape.

ANISEED TYPE :
Illicium anisatum. Cowslip. Primrose. The Indian Lotus (*Nelumbium speciosum*).

VANILLA TYPE :
Azara microphylla. Nigritella. Clematis flammula.

ALMOND TYPE:
Convolvulus. Spiranthes autumnalis. Linnæa borealis.

HAWTHORN TYPE:
Aponogeton. Choisya ternata.

VIOLET GROUP

The scent of the violet is a will-o'-the-wisp. It fatigues the sense of smell very rapidly, and if we try too eagerly to grasp its quality, it fades away and eludes us, leaving only a vague, leafy smell, resembling cucumber. It is one of the most difficult scents to extract from the flower or to reproduce, and its chemical basis is only known by inference. The scent occurs sporadically in widely separated groups of plants, and does not seem to appeal more to one type of insect than another. The Sweet Violet itself is almost independent of insect visitors, for it reproduces itself by hidden self-fertilising "flowers," though it continues to produce its scented blossoms from force of habit or some other reason.

It is much lighter and less heady than the scent of the last two groups, and is especially pleasant for a cool, mossy quality that is rare in flower scents.

It is not a common scent, but occurs fairly pure in *Iris verna* and *Iris reticulata* (only in a warm atmosphere), and in the Orchids *Dendrobium heterocarpum* and *Oncidium ionosmum.* The flowers of *Asparagus tenuifolius* have a distinct violet quality

which is present, though less clearly, in Mignonette and the Vine flower; in Mimosa (*Acacia Farnesiana*) it is combined with hawthorn, and it is said to be perceptible in the White Banksian Rose and the dwarf Polyantha Rose "Eugénie Lamesch." The cultivated Violets vary in the sweetness of their scent, and in some of the very large flowered varieties it has a rather dull, cedar-wood character, instead of the clear sweetness of the wild wood violet.

J. C. House, in the *Journal of the Royal Horticultural Society*, 1919, recommends the following garden Violets for their fragrance: Argentiflora, Semperflorens (Quatres Saisons), Neapolitan, and Mrs. J. J. Astor.

Rose Group

Theophrastus, more than three thousand years ago, praised the rose perfume above all others for its lightness, since "while all or most of the others are heady, this gives actual relief from heaviness and discomfort, even from that caused from other perfumes." And Parkinson writes of the Damask Rose that it is "neyther heady nor too strong, nor stuffing nor unpleasant sweet, as many other flowers." The Rose, like the Violet, has a characteristic quality of lightness, but it enters into more numerous combinations than the violet scent. It is found in but few species of flowers, though in many leaves and roots. It occurs typically in the *Rosa centifolia* and the closely allied *R. gallica* and *R. damascena*, but the scent of a flower is liable to vary as much as its form and colour, so that many varieties of the

rose scent appeared in the plant's long history of selection and hybridisation (see p. 96).

The typical elements of the rose scent are chemically allied to many fruit-scented substances, and the rose scent is therefore often found blended with a fruit scent, not only in the garden Roses, but also in a few wild flowers. In *Rosa bracteata* the rose quality is combined with lemon, with orange in *Tulipa ingens* and *T.* "*Gesneriana*," and with an indefinable fruity scent in *Iris Hoogiana*. There is a distinct rose quality in the scent of *Pæonia albiflora*, which it has handed on to some of its hybrids.

Berberis aquifolia may be included in this group, though its scent has a heavy, rather animal quality which is probably due to indol. *Chamædorea fragrans*, from Bolivia, is said to smell like a tea rose, and *Gentiana pannonica* and *Cypripedium calceolus* are reported to have a rose-like scent. These complete, as far as the writer has been able to discover, the short list of rose-scented flowers.

The Roses produce no nectar, and seem to be visited chiefly by small beetles in search of pollen.

Lemon Group

The lemon scent, with its sharp, refreshing quality, is lighter still than the last. It is closely related chemically to the rose scent, for its typical component, citral, is the first oxidation product of geraniol, and the two substances often occur together, though more commonly in leaves than flowers.

It is not found in many flowers, but appears, blended with other scents, in Magnolia (several

species), *Œnothera cæspitosa*, *Ismene*, *Mirabilis Jalapa*, *Nymphæa odorata*, *Boronia*, and several *Brasso-Cattleya* Orchids.

Fruit-scented Group

The scents of this group shade down from the quince of *Philadelphus microphyllus*, and the orange of *Mirabilis longiflora* through the warmer plum scent of *Freesia* to the apricot scent of *Iris graminea*, which becomes merged with coco-nut in the gorse, where it begins to take on a distinctly animal character.

Animal Group

The animal scents are linked with the fruit scents by the esters of certain fatty acids, of which some have a fruity, and others an animal smell. These substances are closely related chemically, and are therefore liable to occur together in plants, a concurrence that would explain the mixture of animal and fruity smell that we find in *Rosa lutea* (bugs and raspberries), in *Cœlogyne Huettneriana* (animal scent and apples), Black Currant leaves (cats), and the leaves of *Hypericum hircinum* (goat and apples).

The animal smell is found almost pure in all the species of *Codonopsis* (ferret), in the native Lizard Orchid *Himantoglossum hircinum*, in *Crocus graveolens* (blackbeetles), *Cimicifuga*, and in the tropical Orchid *Masdevalia gargantua* ("a disagreeable gamy odour").

The Early Purple Orchis (*O. mascula*) has ordinarily a scent of the vanilla type, but from a

bunch of the flowers, especially when they are fading, there is a distinct suggestion of cats, and the same combination of scents is found in the Flag Iris, appropriately named "Tenebræ." The native *Orchis pyramidalis*, which is sweetly scented by day, gives off a foxy smell at night, and, again, a similar, scent is found in some of the Flag Irises, especially in "Ambassadeur."

Musk and Honey Group

The musk scent of flowers is more like a mixture of honey and beeswax, or perhaps ambergris, than animal musk. It is a difficult scent to classify, but as it seems to have a vague affinity with the scent of the Gorse it is placed at the end of the Fruity group, and parallel with the Animal group.

The scent of the old Musk Plant was fairly like that of the true musk, but all the plants in our gardens lost their scent about twelve years ago, and for no reason that anyone has been able to discover.

The inconspicuous little Musk Orchid (*Herminium monorchis*) has a powerful scent of musk and honey, and *Moschatella adoxa*, which also has inconspicuous flowers, has a dry, waxy smell, faintly tinged with musk; the scent of Sweet Sultan (*Centaurea moschata*) is almost entirely honey in the type plant; the old Musk Rose and our native *Rosa arvensis* have the same scent, suggesting wax and honey (see p. 99).

The flowers of *Delphinium Brunonis* are sweetly musk-scented.

These groups are not hard and fast divisions, for one type of flowers scent grades into another, and

one flower may combine in itself the scent of more than one group, but the nine groups are suggested as rallying-points round which the different flower scents may be grouped for convenience of description. The grouping is biological in so far as the different groups are visited by different types of insects, and in so far as the groups are typified by the predominance of certain chemical substances in their essential oils. But the facts at our disposal are limited, and much of our classification must be still dependent upon the uncertain guidance of our sensory impressions, and therefore tentative.

From the purely sensory point of view it will be seen that the scents, as they are here arranged, vary in a roughly phasic way from the unpleasantly animal scents to the unpleasantly sweet, then with gradually decreasing sweetness, down to the fruit-scented group, where the sweetness begins to fade out again, till it disappears in disagreeable animal scents of another type.

There are flower scents for which it is difficult to find a category: *Hamamelis* has a dry, dusty quality that is barely sweet, and a suggestion of the vaguely animal character of Patchouli, so that it might be placed between the Musk and the Animal groups; *Nymphæa lutea* and *Xerotes spp.* smell of stale brandy, and belong doubtfully to the Fruit-scented group, in which the vinous *Calycanthus floridus* can be included with less hesitation; *Ozothamnus rosmarinifolius* smells of bran, and as it probably contains a trace of vanilla it may perhaps go into the aromatic group. The scent of the garden

phlox seems to be intermediate between the aromatic and the animal, for its sweetness is clearly related to that of the double stocks, but it has in the background a strong smell recalling at first walnuts and then a clean pigsty, a scent not known to the writer in any other flower, though it is given off by the sticky leaves of *Escallonia illinita* and *E. viscosa ;* it is only unpleasant on account of its associations.

The reader will no doubt discover other flower scents that are difficult or impossible to classify.

PART III

The Classification of Scented Leaves

There is an immense variety in the scent of leaves, and an orderly classification of them would be very long and complicated. But many of them are scarcely fragrant, and of small interest to the gardener or the general reader; so, for the present purpose, it is more convenient to make three rough groups of the leaf scents which are quite unlike the flower scents, add to it a convenient but unscientific miscellaneous group, and classify the other leaf scents according to the types of flower scent that they most resemble.

The unflowerlike leaf scents may be grouped as follows:

Turpentine Group:
Type: pine needles.
Essential oil : borneol and borneol acetate.

Camphoraceous Group:
Type : Wormwood, Yarrow, Sage, etc.
Essential oil : eucalyptol, camphor.

MINT GROUP:
Type : Mint.
Essential oil : menthol.

MISCELLANEOUS GROUP:
Parsley, Onions, Garlic, Watercress, Celery, etc.

The *turpentine scent* occurs throughout the conifers and in various other leaves. It has a pleasantly fragrant quality in the glandular hairs of the Moss Rose and the wild Agrimony.

The *Camphoraceous Group* is a very large one, and besides Wormwood (*Artemisia*), Yarrow (*Achillea*), and Sage (*Salvia officinalis*), would include Lavender Cotton (*Santolina*), Chamomile, *Micromeria Corsica*, Nepeta (Catmint), Wild or Pot Marjoram, Camphorosma, Tansy, the Thymes, and many others.

Micromeria Corsica has a very curious and complex scent, which Mr. Clarence Elliott describes, very justly, as a "mixture of oysters and lemon juice," while to the writer there seems to be a slight trace of rose in it as well. It is very pungent, for it affects the tactile nerve endings as well as the olfactory, and easily provokes sneezing. Cats are passionately fond of it, rolling on it with expressions of ecstatic delight, and often destroying it in the rock garden.

Rosemary may be placed in this group, though its scent has some of the spicy quality of nutmeg.

The essential oil of the *Mint Group* contains the characteristic alcohol, menthol, which affects other nerve endings as well as the olfactory, and produces a general sensation of cold. It occurs in some species

of Eucalyptus and scented Geraniums as well as in the mints.

No leaves have a scent comparable with that of the heavy-scented flowers, which is due to substances peculiar to them alone, but a rough similarity enables many leaves to be classified under the other groups of flower scents.

Several "Stink Woods," such as *Celtis reticulata*, may be placed in the *Indoloid Group*. The Stinking Goosegrass (*Chenopodium vulvaria*) and Dog's Mercury (*Mercurialis perennis*) contain *trimethylamine*, and may therefore be placed in the *Aminoid Group*, although, unlike the Hawthorn, Rowan, etc., they have no trace of sweetness.

The *Aromatic Group* will contain all the spices, the sweet balsams, such as Myrrh, Balm of Gilead (*Commiphora spp.*), Styrax (*Liquidambar orientale*), Frankincense (*Boswellia Olibanum*), Balsam of Peru and Tolu (*Myroxylon spp.*), Galbanum, Opopanax (*O. chironium*); *Humea elegans*, whose leaves smell of incense and Russian leather; Bay, and the leaves that resemble it, such as Myrtle, Bog Myrtle, *Chimonanthus fragrans*, and *Illicium religiosum*, etc. The many leaves that smell of new mown hay, such as Woodruff, the fern *Lastræa aemula*, and the Tonka bean, and those that contain oil of Wintergreen (*Gaultheria procumbens, Meadowsweet, Betula lenta*), may also be included.

There are few woods and roots whose scent has a violet quality. Orris root is the underground rhizome of several species of Flag Iris (*Iris pallida*,

I. "*Florentina*," etc.), but it requires a hot sun to develop the characteristic scent, which only appears after the rhizomes have been dried for several months, and continues to increase for two or three years. The scent of the Australian Mial Wood (*Acacia homophylla*), which was at one time used for making pipes, is distinctly like violet. The young shoots of a palm, *Genonoma pumila*, are said to smell of violets, and the wood of *Bulnesia Sarmentii* of violets and tea. Khus-khus or Vetiver, the root of the Indian grass *Vetivera zizanoides*, has a pleasant violet quality, and the scent of *Veronica cupressoides*, which is most apparent after a shower of rain, is almost identical with it. Costus, the root of a Himalayan composite *Aplotaxus lappa*, faintly recalls violet, but develops with age a curious quality, which at first suggests human hair, and later becomes distinctly goat-like. It was much used in classical times, and is still a favourite perfume in the East. Cedar wood, by which we usually mean the wood of *Juniperus Virginiana* and not the less fragrant Cedar of Lebanon, has some slight affinity with violet, and so may be included in this group.

Many roots and leaves belong to the Rose group. The Rose Leaf Geranium (*P. capitatum* and hybrids) is largely cultivated in Algeria for its essential oil, which, besides its legitimate use in perfumery, fills the little tubes of "Otto of Rose" which are sold in Eastern bazaars, and used to find its way into the rose stills in Bulgaria. The Indian "Palma Rosa Grass" (*Cymbopogon Martini*) is also cultivated for

its oil. The wood of *Convolvulus scoparius* (Canary Islands) and Brazilian Rosewood (*Physocalymna floribundum*), the root of *Sedum Rhodiola* (the " Rose Root " of old cottage gardens) and *Asarum Canadense*, all smell more or less sweetly of rose.

The lemon scent is found in comparatively few flowers, but in many leaves. It occurs almost pure in some of the Indian grasses of the *Cymbopogon* group, and in some species of Eucalyptus; softened with rose in the Lemon Verbena; less sweet in Balm (*Melissa officinalis*); in *Pelargonium crispum* and, mixed with peppermint, in some of its hybrids; mixed with eucalyptol in Lemon Thyme, mixed with mint in the Lemon Mint, and with camphor in *Cedronella triphylla ;* mixed with an elusive seaweed smell in *Micromeria Corsica*, and with varying degrees of orange blossom and rose in the fruits of the Citrus family.

The *fruity scents* are less varied in leaves than in flowers. An apple scent is fairly common, and occurs in Sweet Briar (which is sometimes described as " vinous "), in the Apple Mint (a variety of *Mentha rotundifolia*), in *Thuya Lobbii* and some of the *Pittosporums ;* it is mixed with lemon in *Acorus Calamus*, the Sweet Flag that was used in the Middle Ages for strewing the floors. The leaves of the Citrus family have a scent more or less like bergamot, and related to the scent of their flowers and fruit. An orange scent is found in the Orange Mint (*Mentha citrata*), and a tangerine scent, with a good deal of added pungency, in *Thymus Azoricus.*

Salvia rutilans smells of pineapple and eucalyptol;

Bee Balm (*Monarda didyma*) of bergamot. Lavender will be included in this group since its fresh, stimulating quality is due to the bergamot-scented linalyl acetate.

The *Animal Group* is linked to the last by *Hypericum hircinum*, the St. John's Wort, that smells of apples and goats, and by *Citriosma oligandra* (bergamot and goats), which is said to suggest the characteristic smell of the negro and is known in Brazil as "Catinga de Nigra."

Most of the frankly animal-smelling leaves, such as Crown Imperial, *Crucianella stylosa* ("Old Foxy"), and several species of Azalea, suggest a fox in the garden; and a foxy smell can also be detected in the resinous scent of Hyssop and *Dictamus Fraxinella*.

The leaves and root of the Valerians develop a thoroughly unpleasant smell as they wither, which recalls an old dog kennel. In the nearly related *Nardostachys jatamansi*, the true Spikenard, the leaves smell strongly of valerian, but the root, even when fresh, has a pleasant scent of patchouli, slightly sweetened with something resembling musk. *Valeriana celtica*, the "Speick" of the Austrian Tyrol, which has the valerian quality slightly modified by a hint of patchouli, is used by the peasants to put in their linen cupboards, and was at one time exported to the East in large quantities as a substitute for the true Spikenard.

Patchouli itself is an Indian Labiate, and its scent, which is only developed as the leaves dry, is very difficult to describe. It has been compared to old clothes and dry moss, while to the writer it

recalls sable fur with a faint sweetness in the background. Most people find it pleasant, or at least interesting; some people dislike it; and nearly all fail to recognise it, for by an artificial association the name evokes the idea of a very sweet and heavy perfume, and we hardly ever meet the real scent in these days except in Chinese ink and old Oriental embroideries.

To the Musk and Honey Group belong the tender *Olearia argophylla* and *O. moschata*, whose leaves are said to smell of musk; the Sumbul root (*Euryangium sumbul*), whose origin was long a well-kept secret in Eastern Turkestan until a plant was purchased for a vast sum by the Russian Government; the seeds of *Hibiscus abelmoschus* and Angelica, whose scent has a faintly musky quality.

Labdanum, the leaf gum of several species of Cistus, and the resin of the Poplar buds (*Populus balsamifera*), have a similar scent, which has something in common with ambergris.

The vanished scent of the old Musk plant may be have been due, in part at least, to the glandular hairs with which it is covered. The leaves of Clary (*Salvia Sclarea*), though they have rather a disagreeable smell, which suggests black currants, yield, on distillation, an oil with a pleasant and powerful muscat scent. The essential oil of walnut leaves is said to have an odour of tea and ambergris, and oil of Elecampane (*Inula helenium*) of labdanum.

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CHAPTER IX

OUR APPRECIATION OF SCENT

OUR appreciation of scent is relatively simple, for it has never been elaborated into an art, and the olfactory impressions have never been used seriously as a means of expressing our emotions and ideas. Yet, so far as the writer is aware, no theory has been put forward which explains satisfactorily why we like that group of scents that we call sweet.

It simplifies the question to use the word "sweet" rather than "pleasant"; for many scents, such as the scent of newly baked bread and of the earth after rain, are pleasant but are not "sweet" in the more definite sense in which we use this word of the scent of Jasmine and Syringa.

If we make a list of sweet scents we shall find that the sweetest are those of the Heavy and Aromatic group of flowers and that, in general, a scent, whether animal, vegetable, or chemical, is "sweet" in so far as it resembles these flower scents.

There are one or two apparent exceptions to this rule. These will be discussed later, and, for the sake of clearness, we will proceed at once to see what follows from this idea, since it seems to explain why it is we like sweet scents.

We have seen that the Heavy and Aromatic flower scents have been evolved to match the scents of the

moths and butterflies that visit them, and that the scent of the butterflies plays a part in their courtship and serves to stimulate the mating instinct. We therefore react to the same scents in the same way as the moths and butterflies; and, unless we have met a very remarkable coincidence, we do so for the same reason. This conclusion, that the sweet scents unconsciously stir the old mating instinct, has been reached, on other grounds, by almost all observers who have studied the subject, and it is one from which we can scarcely escape when we notice that the use of perfume is limited to one sex in our western civilisation, as the production of scent is limited to one sex in the moths, butterflies, musk deer, and crocodile.

But a scent is not sweet simply because it stirs the mating instinct, as some writers seem to imply, for the facts are quite otherwise. An obviously sexual scent, such as that of the stinking goose grass and privet, is definitely unpleasant; and reputedly aphrodisiac scents with an animal quality, such as patchouli and *Valeriana celtica*, are not sweet, at any rate to the Western nations.

The legitimate conclusion seems to be this, that *a sweet scent is one that can stir the instinct of courtship without evoking the idea of the natural end object of the instinct.* It seems more exact to use the word "courtship" rather than "mating" in our definition since the appeal of scent, in civilised man, is associated with the stirring of an emotion and not with the satisfaction of it. Since no object for the wakened instinct is presented to consciousness, the emotion

set free is diffused into a vaguely pleasurable state, which is the characteristic effect produced upon us by a sweet scent. It may here be noted that music is not the only form of beauty that hath charms to soothe the savage breast, and the incense of church and temple may be more efficient in banishing evil spirits than is commonly supposed.

Our definition of a sweet scent affords a basis from which to explain certain individual and national preferences for different types of scent, for the sweetness of the scent depends upon the degree to which it stirs the primitive instinct. More exactly it depends upon the sensitiveness of the individual, and upon his capacity to appreciate and remain content with a vague and tenuous emotion. English people in general show a preference for rose, lavender, violet, and the more definitely aromatic scents, like clove pink; the heavier scents, such as jasmine, gardenia, etc., are apt to seem too sweet, and to evoke a vague feeling of uneasiness. The Latin races seem to be less sensitive, and they can enjoy scents which we find unpleasantly sweet and heavy. If we may adventure upon the uncertain field of racial temperaments, this taste may be connected with a certain simplicity of the emotional life, and with a tendency for the emotions to flow in slightly primitive channels rather than to diffuse easily into wide spheres of interest.

In the Eastern nations the preference for heavy scents is still more marked, and is extended to an appreciation of scents with a strongly animal quality, such as patchouli, spikenard, and costus. This

tendency reaches its limit in the use of crocodile musk by the natives of Somaliland.

This gradation of the sweetness of scents in general may be traced also in particular groups of scents for there are several which may be arranged in a descending scale of sweetness which coincides with an increasingly animal quality. In the series cowslip, apricots, gorse, coco-nut, the sweetness gradually fades out, and vanishes in the animal smell of the coco-nut, whose essential oil contains substances related to the goaty-smelling caproic acid. The sweetness of the violet diminishes in the series violet, orris root, khus-khus, cedar wood, patchouli. It may be suggested that the last two scents are similar to the scent of a clean, healthy human body, and it may be recalled in this connection that certain individuals have been noticed to have a natural scent of violets, such as many people remarked in Walt Whitman.

Havelock Ellis has noted the connection between the natural human scent and perfumes, and there is little doubt but that our appreciation of sweet scents has its remote origin in the former. But our appreciation of scent, in the course of its evolution, has left its primitive origin far behind, and the distance travelled is brought home to us by the scent of the tropical orchid *Dendrobium Devonianum*, which has a distinctly human scent mixed with its sweetness, and is said to recall a dance room on a warm evening—a quality that detracts, for our civilised senses, from its fragrance instead of enhancing it. The flowers of the Henna plant

(*Lawsonia inermis*) are said to have a similar character.

There is at least one sweet scent, that of indol and the nearly related scatol, in which the gradation from sweet to the animal and unpleasant may be traced through different dilutions of one and the same substance; indol and scatol occur in decomposing animal matter and in excreta, and they are probably given off in minute amount by the human skin; indol is found in the attar of many of the heavy-scented flowers, and scatol is the active principle of civet. At a very high dilution both these substances have a pleasant flowery scent, recalling jonquil; when slightly stronger an element suggesting old clothes and sable fur comes in, which rapidly passes, with increasing concentration, into the smell of the lion house at the Zoo, and then into a frank stench. Even at its highest dilutions, when it is very sweet, this scent trembles on the edge of being unpleasant, for it lies very near the limit beyond which the nature of the stimulus becomes evident.

The apparent exceptions to the rule that a scent is sweet in so far as it resembles the heavy and aromatic flower scents are the leaf scents (which have already been discussed in this connection in Chapter II.), the animal scents, and the fruit scents.

It is tolerably clear that we like the animal scents, musk and civet, because they are flowery; since, on presenting a sample of pure animal musk to some twenty-five different people, the writer found that all except one (who was a perfumer) failed to identify it, and all except one, who found it too sweet,

described it pleasant and "like some flower." The scent of the civet, when very dilute, is almost exactly like that of the jonquil, *Narcissus rugulosus odoratus*.

The fruit scents are more debatable; yet it can hardly be said that they appeal to our instinct of hunger by suggesting something good to eat, for the fragrant fruits, though they gratify our sense of taste (*i.e.*, smell, so far as their flavour is concerned), do little to satisfy our hunger, as anyone will know who has been accidentally reduced to them alone. All the fruit scents are found also in the flowers, and in the classification they are placed at the farthest remove from the Heavy and Aromatic groups.

It therefore seems likely that the fruit scents seem sweet to us because they appeal to the same instinct as do the flower scents, though less powerfully — a theory which would explain more adequately why Schiller used the scent of apples and de Maupassant a mixture of ether and strawberries to stimulate their imagination than by supposing that these scents stimulate the instinct of hunger.

It was said, at the beginning of the chapter, that the olfactory impressions had never been made the basis of an art. But this is not strictly true, for the perfumer, in analysing the natural scents and reassembling them into new combinations, follows certain rules, which, though indefinite and unformulated, are none the less generally recognised; and he is working in a way not very different from that of the artist who selects, combines, and reproduces the elements of natural beauty. The accomplishment of the skilful perfumer is far nearer to a work

of art than the attempts of certain enthusiasts to force scents into analogy with the notes of the musical scale, and make organs and symphonies of perfume. Perhaps, after all, these attempts are only premature; they fail because of the difficulty of recalling a scent to memory, which prevents a succession of scents from producing any effect of rhythm. But the difficulty of recalling scents, like the difficulty of discriminating between them, seems to be due to lack of interest; for it is easier to recall flavours than scents, though both are due to sensory impressions of the same kind. If, therefore, the olfactory impressions were accorded a greater share of interest, it might one day be possible to appreciate them in complex groups containing harmonies and contrasts, and even to link together, for effect, impressions that were presented successively.

But for the present the art of the perfumer is essentially static; and he is wisely content to follow the taste of the public rather than attempt the doubtful experiment of trying to educate it.

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CHAPTER X

SCENT IN THE GARDEN

GARDENERS have always appreciated the scent of flowers, and nearly the whole range of flower scents will usually be found in the average garden, although the flowers there may not have been selected with any special thought for their fragrance.

It would be quite easy to fill a garden with scented flowers only, but it would hardly be worth while thus to limit our choice, except perhaps in the smallest of possible gardens. But any garden will gain interest if we remember that for many a scentless shrub or flower there may be another equally suitable and beautiful with the added quality of fragrance.

The scents of flowers do not seem to clash in the open air, perhaps because most of them have several elements in common. There is therefore no need to group them in any special way, except to take care that the more delicate are not overwhelmed by the stronger. But it is well worth while to pay a little attention to the scent of flowers that we plant near the house, so that we may enjoy it as it comes drifting in through the windows on a summer evening or on the first warm day of spring.

There are many sweet-scented creepers which may be given a position of advantage near the

windows, but we may remember that jasmine is sometimes too powerful in a hot summer, and is apt to grow rather wildly. In choosing other plants to grow near the house, it is well to select those that can be grown in masses, and preference may be given to the twilight and night scented flowers. The following may be suggested as examples: *Night-scented Stock* (a heavily balsamic scent with a long range), *Double Stocks, Double Rocket* (resembles the the last; the plants should be moved every other year), *Lychnis vespertina fl. pl.* (Heavy group, a very old-fashioned plant), *Schizopetalon Walkeri* (the scent is rather disappointing, almond and hawthorn), *Border pinks* (*Dianthus fragrans fl. pl.*, a small double white, is more delicately scented than the others; *D. squarrosus* is said to be lemon scented), *Mignonette* (Violet group, the scent is best in the more ordinary varieties, and on a poor limy soil), *Wallflowers* (especially the old double forms, of which "Harpur Crewe" is said to smell of mignonette). One or two scented flowers are so sweet that most people prefer them at some little distance from the house so that their scent may be caught occasionally as it drifts about the garden; such are: *Syringa* (*Philadelphus;* some of the hybrids of *Ph. Coronarius* are less heavily scented than the parent, and *Ph. microphylla*, though its powerful scent of quinces and melon is not very delicate, only makes a small bush, and is not obtrusive), the *Tobacco Plant*, and most lilies.

It is quite possible to have scented flowers in the garden the whole year round; the autumn flowers,

of which a selection is given in the appendix, need no special arrangement, but those which bloom in the winter and early spring appreciate some protection from the rough weather, and, for their common needs, may be grouped together in some sheltered corner to make a scented garden of winter flowers. If a south wall is available, so much the better, but a yew hedge or a bank topped with *Berberis Mahonia* or other evergreen shrubs will serve, and these may be used to make a wind break on the east side. *Chimonanthus fragrans* (January; hyacinth scented) will appreciate, though it does not actually need, the shelter of the wall. The tousled yellow flowers of *Hamamelis arborea* and *H. mollis* (February; a dry dusty scent, recalling patchouli) show up best against a background of dark evergreens. *Daphne Mezereon* prefers the shady side; a large-flowered pink form, and the one good white (there is a very inferior albino) are better than the type. The heavy scent, which would be cloying in the summer, strikes a note of keen, thrilling sweetness in the bleak wind of February. *Berberis Bealii* (February or earlier) also likes shade and shelter, its racemes of sulphur-yellow flowers have a powerful scent of lily of the valley, though behind it on a warm day and at close quarters can be detected the fœtor of pure civet.

Three of the most valuable shrubs that have lately reached our gardens, *Viburnum Carlesi, V. fragrans,* and *Osmanthus Delavayi,* bloom early in the year, and are very sweetly scented. *Viburnum fragrans,* from Western China, opens its waxy, pink-flushed

buds early in February, and they have been seen spangled with hoar-frost but still undamaged (hyacinth with a dash of vanilla). *Viburnum Carlesi* (end of March and early April) has a powerful scent, like that of *V. fragrans*, but with a faint clove element. *Osmanthus Delavayi* covers a neat evergreen bush with milk-white flowers between the flowering time of the last two (scent recalls jasmine).

The bush honeysuckles *Lonicera fragrantissima* and *Standishi* (honeysuckle and orange), will open their flowers on mild days throughout the winter, but they usually produce them rather sparingly; *Lonicera syringantha* flowers much more freely and decoratively in the earliest days of spring (hyacinth scent).

The Glastonbury Thorn gives a queer foretaste of spring by blossoming sometimes on Christmas Day, more often according to the old calendar than the new. It sprang, according to tradition, from the staff of Joseph of Arimathea, after a sermon of unavailing eloquence to our pagan forefathers at Glastonbury, and although most of the plants in the old monastery gardens were destroyed at the Reformation, some were left whose descendants may be found in a few nurseries to-day under the name *Cratægus oxycantha var. præcox*. *Sarcococca humilis* and *S. ruscifolia* flower in early spring, like shade, and provide a background of shining evergreen leaves (scent, heavy and very sweet, suggesting a single compound rather than a well-blended mixture).

Iris stylosa, or more accurately *I. unguicularis* (primrose and honey), is the most valuable of the smaller plants of the winter garden, for its flowers

are well protected by stiff leaves. It blooms from October to March, partly according to the variety, partly according to the weather; it flowers earlier and more freely after a good baking summer. It should be planted in poor, limy, and well-drained soil, at the foot of a south wall or on a bank, and the flowers may be conveniently picked in bud and allowed to open in the house. Violets will open early in a sheltered corner, and few varieties are sweeter or more vigorous than the single white, which is naturalised in many woods.

March will bring in the Muscari: *M. botryoides* (fruit and musk) *M. moschatum* (dingy, but with a strong and almost pure musk scent), *Triteleia uniflora* (? violet), and the jonquils (*Narcissus odorus* and *rugulosus*), whose scent is too heavy for most people, but interesting for its likeness to civet.

Many early-flowering plants are best grown in a cold greenhouse, or in deep pans, plunged in a frame and brought into the house just before they flower, for, except in the most sheltered districts, their flowers are likely to be damaged by wind and rain. Such are *Iris reticulata* (violets), *I. persica* and *sindpers* (almond), *Crocus lævigatus* (cowslip, November, December), *C. imperati* (cowslip, January), *C. chrysanthus* (January, primrose and musk), *Gladiolus tristis*, scentless by day, but beginning, about an hour before sunset, and often quite suddenly, to give out a scent of pansies, which rapidly deepens to an aromatic quality resembling the double stocks.

Tussilago fragrans has the merit of flowering in

winter, and a scent remotely like heliotrope, but it is a rampant, invasive weed, and should never be allowed in or near the garden, to which it sometimes seeks admission under the alias "*Nardosmia*."

Small Scented Plants

There are a number of sweet-scented flowers, mostly rock or alpine, whose fragrance is liable to escape notice because they grow out of convenient reach of our noses.

The alpines may be brought within range by growing them on the upper ledges of the rock garden, but this presupposes a generous scale of construction that is not within the means of all gardeners. An easier method is to grow them in a dry wall or in an old stone sink or trough raised on brick piles. These last make a very satisfactory home for alpine plants, for they are not out of place in the smallest garden, and they avoid the almost insuperable difficulty of bringing a rock garden into harmony with its surroundings, by setting a simple frame round the patch of scree or flowered boulders, which thus becomes a minute excerpt of natural scenery rather than an attempt to imitate it on a diminished scale. Using a scree mixture we can grow: *Petrocallis pyrenaica* (vanilla), *Thlaspi spp.* (hawthorn and lilac), *Alpine Poppy* (hawthorn and musk), *Morisia hypogæa* (hawthorn), *Cyclamen Europæum* (north side of boulder, scent musk and civet), *Daphne petræa* (south side of boulder). In richer soil: *Dianthus Sternbergii* (a dwarf, large-flowered form of *D. Monspessulanus*, delicate clove scent) or *D.*

arvernensis (a compact form of the Cheddar pink), *Orchis ustulata, Spiranthes autumnalis* (almond), *Daphne arbuscula,* and others.

Scented Flowers in the House

Some flowers need a warm atmosphere to bring out their scent, and if they bloom early in the year they seldom get it in this country, so that their fragrance is best appreciated if they are allowed to open in a warm room. Many Tulips, such as "Ellen Willmot," "Primrose Beauty," "Macrospila," etc., have a delicate fruity scent, often suggesting a mixture of rose and orange, which is hardly powerful enough to have much effect in the open air; while many Tea and Hybrid Tea Roses only develop the the full character of their scent indoors.

The dwarf White Evening Primrose, *Œnothera eximia syn. marginata,* is very beautiful when its great white chalices are seen floating over the clump of rough leaves in the twilight; but its design and scent can be appreciated better if the long, fat buds are picked just before sunset and put in water. They will open during dinner and continue to pour out their scent of lemon and tuberose till daylight, when they begin to turn rosy pink and fade, having waited in vain for the South American hawk moth, which alone can reach the nectar in their five-inch corolla-tubes.

One or two of the clove-scented carnations will fill a room with their scent, which seems especially suited to the house because it is almost unflowerlike in its rich spiciness, and is far from giving that faint

impression of incongruity with the surroundings that we sometimes feel when scents which have a close association with the countryside, such as cowslip or honeysuckle, are taken out of their natural setting and brought into our own. All florists' flowers, when brought indoors, have this advantage over the wild species, of compatibility with the house; but only in the Rose and Clove Carnation has a scent been evolved to match the sophisticated beauty of the flower. All scented flowers are out of place on the dinner table, and if the reader doubt it, let him imagine the combination of lobster and hyacinth.

The scent of some flowers can only be enjoyed in the garden, some because they are too powerful in the house, others, such as Mignonette and Wallflower, for the opposite reason, that they tend to lose their scent when brought in out of the sunlight.

It is worth noting that the tendency of *Daphne Mezereon* to die suddenly and unaccountably seems to be aggravated by cutting its branches while they are flowering, but that *Chimonanthus fragrans* and *Virburnum Carlesi* may be judiciously pruned by cutting a few flowering twigs for the house.

Scented Leaves in the Garden

A few fragrant leaves give out their scent spontaneously, either after a shower, like sweet briar and *Veronica cupressoides* (cedar wood and violet), or under a hot sun, like the cistus family and *Rubus odoratus* (cedar wood and sweet briar, from the magenta hairs that cover the young shoots). But

most need to be brushed against or bruised before they give out their scent, and they will naturally be planted within reach of the hand. All gardeners know the value of the erect Lemon Thyme, with its gold and silver varieties, for a formal edging; Lavender Cotton, especially the compact dwarf form sold as *Santolina squarrosa*, and the dwarf Lavenders may be used in the same way. A rough stone edging to the border, raising it a little above the surrounding level, provides good drainage and a good setting for many aromatic rock plants, the tufted Thymes, *Th. Azoricus* (orange), *Th. nitidus*, *Th. erectus*, etc., the allied *Micromerias* and *Satureias*, the dwarf *Artemisias*, *Helichrysum rosmarinifolium*, *Leontopodium aloysiodorum* (the lemon-scented Edelweiss), the dwarf Marjorams and others.

The prostrate Thymes, which are very easily propagated, may be planted close together in their many varieties to form a close turf, and Mr. Clarence Elliott has used them very effectively in this way to form a broad approach to the rock garden. Planted thus they may be walked on or sat on with much less damage than when they are set in crevices of a crazy pavement. Two prostrate Thymes, *Th. Herba Barona* (carraway) and *Th. fragrantissimus* (a pleasant fruity scent, not distinctly lemon), should not be left out.

Many aromatic plants come, as we have seen, from hot dry places, and deserve a well-drained sunny border; as many of them have grey leaves, they make an excellent background for other plants

of similar requirements. The lemon-scented Verbena (*Aloysia citroidora*) is much hardier than commonly supposed, and will survive the severest winters against a wall in light soil if it is protected with a little bracken during the winter and kept compact by picking a few sprays during the summer; one or two leaves greatly improve a jug of lemon squash. *Cedronella triphylla* (lemon and camphor), *Salvia rutilans* (pineapple), which is often sold under the name *Salvia Grahami* (a similar plant with a coarse black-currant scent), are rather less tender; and Rosemary is, of course, generally hardy, though, in a cold, bleak district, it will appreciate a warm border or a wall. The scent of *Dictamus Fraxinella* (resin and rue) is not very pleasant, but the oil is given off so freely that if the bush is touched with a match at the end of a very hot day it will (sometimes) light with a flash of blue flame. The most fragrant plant of all, *Humea elegans* (Russian leather and incense), is frankly tender, but may be planted out for the summer.

The Herb Garden

The herb garden of our ancestors may be reproduced without much difficulty, if its literary associations seem to make it worth while. But most of the old herbs were more beautiful in their names—Sweet Cicely, Tansy, and Elecampane—than in their scent, and the best of them, Lavender, Rosemary and Balm (*Melissa officinalis*), have long since migrated to the border. *Alecost* is useful because its mint-scented leaves are almost evergreen, and may be used for

mint sauce during the winter. Sweet Marjoram is tender, but easily raised from seed, and smells pleasantly of camphor and cedar wood. Sweet Cicely (*Myrrhis odorata*) has a very homely smell of aniseed, but its sweetness lies in the sugary taste of its leaves.

The Mints produce several varieties, or they may be true species, with different scents. *Mentha gentilis* is said to smell of lemon and *Mentha citrata* of orange, but the writer has been unable to procure them. Apple Mint is a variety of *Mentha rotundifolia*, and the leaves, especially in autumn, smell of pippins and mint. There is a pretty, silver variegated form of it which makes a good background to Welsh Poppies in a shady corner, which will also be appreciated by Balm (though this will grow invasively anywhere) and by *Monarda didyma* (Bergamot), which has a rough, refreshing scent of resin and bergamot. The Sweet Flag (*Acorus calamus*), whose leaves, scented with lemon and apples, were used in the Middle Ages for strewing the floors, and *Cyperus longus* (Sweet Sedge) will grow by the waterside with Bog Myrtle (*Myrica Gale*). The scent of *Cyperus longus* is found only in the rhizome, which smells of bay with a hint of orris. A bush of Bay ought to find a place in a sheltered corner if only because its leaves are so useful in the kitchen and indispensable to a good marinade. Of other shrubs, the leaves of *Chimonanthus fragrans* have a scent of the bay and myrtle type, to be valued the more because we usually have to wait some years for the flowers; *Illicium religiosum* has a similar scent but

very pungent; the leaves of *Calycanthus floridus* are faintly spicy, and *Thuya Lobbii* makes an evergreen, apple-scented hedge.

The Scent of the Rose

The garden Roses of to-day have been built up out of many different species and varieties, crossed and recrossed in endless combination; and their mixed parentage, together with the natural tendency to variation, has produced many different kinds of scent. Sometimes the scent is distinct and individual, more often it is a blend of one or more types, but in almost all Roses there is a background, more or less obvious, of the scent of the *Centifolia-Damascena-Gallica* group which, under the name of the "old rose scent," is generally regarded as the typical scent of the rose.

The introduction of *Rosa indica* (*Chinensis*) *odorata* as a parent profoundly modified the old rose scent, giving not only a tea-scented rose, but a great variety of fruit-scented roses as well. The fruit scent was intensified and varied by the influence of the Austrian Briar (*R. lutea*), which sometimes almost excluded the old rose element altogether; a spicy quality was introduced by the Himalayan *R. moschata*, and honey scent perhaps by *R. arvensis*. These were the chief factors acting upon the scent of the garden roses from without; but there are also internal factors, for, as we have seen in Chapter II., the typical attar of roses prepared from the Damask Rose contains fruit, honey, spice-scented and other substances in addition to the pure rose element,

and the proportion of these is liable to vary like any other botanical character, and so to give rise to new varieties of scent.

The scent of individual roses is often very difficult to classify and even to describe, but, out of the rich and subtle variety of scents that they provide, we may conveniently distinguish five main types, which will serve as rallying-points round which to group them, and as the basis for a rather rough classification.

If, quite unscientifically, we place together in a separate category a number of individual and unrelated scents, the classification suggested would stand as follows:

Group I.: Old Rose scent.
Group II.: Tea scent.
Group III.: Fruit scent.
Group IV.: "Musk" scent.
Group V.: Spicy scent.
Group VI.: Individual scents.

Group I.—Old Rose Scent.

The old Rose scent is found typically in the Damask, the Provence or Cabbage Rose, the Gallica Rose, and, with a slight difference, in *R. rugosa*, and it has been transmitted to many Hybrid Perpetuals and some Hybrid Teas. It seems to be linked biologically with the colours red, pink, and white, for although it occurs, more or less clearly, in several pink-flowered species—*e.g.*, *R. lucida* and *R. nitida* in addition to those already mentioned—it is never found in the wild yellow Roses, which are either scentless, as *R. Hugonis*, *R. hemisphærica*, *R. hispida*,

and *R. Ecæ*, or have a peculiar scent of their own, as *R. lutea* and *R. indica odorata ;* nor is it ever found, so far as the writer is aware, in any garden Rose in which yellow predominates.

The old rose scent varies from the full rich scent of some of the Hybrid Perpetuals to the light, delicate scent of the Scotch roses; and examples of many varieties will be found in the list of scented Roses at the end of the section.

Group II.—Tea Scent.

Many careful observers fail to find any likeness between the "tea scent" of roses and that of dry China tea, which it is commonly supposed to resemble, and consider it more like the fragrance of ripe raspberries. This last scent is certainly well marked and common in Tea Roses and Hybrid Teas, but to the writer there is a distinct suggestion of China tea in one or two Tea Roses, especially of the Dijon class, though it may be literally a suggestion due to long familiarity with the name.

Group III.—Fruit Scent.

A fruit scent is very common in the modern Roses, ranging from the heavy apricot scent of Golden Emblem to the sharper orange of Louis Barbier. It is found in at least two species, *Rosa bracteata* (the tender McCartney Rose), which has a delicate lemon quality, and *Rosa lutea* (the Austrian Copper), whose stuffy smell of bugs, or rather of fresh coriander seeds, becomes quite pleasant and distinctly like fruit when diluted by distance or hybridisation.

Group IV.—"Musk" Scent.

The so-called "musk scent" in Roses is, by general agreement, quite unlike animal musk, and it is possible that it was applied at a time when "musk" was sometimes used as a synonym for fragrance. To most people it is more like beeswax and honey with perhaps a suggestion of ambergris. It is found typically in the native *R. arvensis*, of which the old Musk Rose was probably a variety, and in some of its hybrids, such as Una and Jersey Beauty.

It has a dry, rather dusty quality direct from the flower, and is sweetest as it drifts from the bush on damp evenings.

Group V.—Spicy Scent.

The Himalayan Musk Rose, *R. moschata*, and its variety or natural hybrid *R. Brunonis* have a distinct clove scent, which appears as a spicy, rather cinnamic quality in some of their hybrids, such as Danäe, Cornelia, and Fairy, whose scent, slightly coarse and unlike a rose scent, suggests the wild Hyacinth. Dr. Blondel records a scent of hyacinth in Unique Jaune, a Noisette Rose, and therefore, presumably, of musk parentage. A clove quality is perceptible in Irish Elegance, and Mr. Darlington tells the writer that some forms of *R. indica* have a well-marked spicy scent.

Group VI.—Individual Scent.

The Dog Rose (*R. canina*), especially in the deeper-coloured varieties, has a fresh, clear scent, which Dr. Blondel compares with mignonette. It is, perhaps,

an intensification of the mignonette element that gives us the violet scent of the White Banksian Rose and of Eugénie Lamesch.

The Moss Roses have a refreshing, slightly resinous smell, which comes from the glandular hairs of the calyx and recalls the scent of the wild Agrimony, which has the same origin. Camöens and Mrs. Edith Pavell have a rather disagreeable smell of beer in addition to the rose scent. Etoile de Hollande has a deep, powerful scent with a distinct muscat quality that perhaps entitles it to a place among the individual scents.

The scent of the Austrian Briar, already described, belongs properly to this group.

M. Jules Graveraux, in a note in the *Journal des Roses* (1909, p. 101), describes a variety of curious scents in Roses (tarragon, pepper, elder, Russian leather, etc.), but his comparisons are not always easy to follow or confirm.

It is sometimes said that the modern Roses are not so fragrant as the old varieties, and it is sometimes suggested that they are even losing their scent, but this is only a very careless criticism, and quite unjustified by facts. For there have always been scentless Roses, though, for this defect, most of them have passed out of memory as well as cultivation, and only those are noticed which appear inevitably among the great number of new varieties that are produced every year.

The rose scent, so far from tending to disappear, is a strong and persistent biological character, and

Mr. E. J. Holland has pointed out (in the *Rose Annual*, 1923) that it tends to reappear in the second and subsequent crosses of scentless Roses. Frau Karl Druschki (Snow Queen), which is often decried, in spite of many good qualities, for its scentlessness, has already produced some sweet-scented seedlings.

It is, perhaps, not so much the lack of fragrance in many modern Roses as the absence of the old rose scent which has attracted the attention of the general public; and this is due to the great popularity of yellow and orange Roses which, as we have seen, never carry the old rose scent. Some of these new Roses, which have been put into commerce in great numbers to meet the demand, are scentless, and will no doubt be superseded; but many have a very excellent fragrance, usually of the fruit-scented group, and if it has not been generally recognised, it is probably because the public, expecting a familiar scent, is a little slow to notice and accept an unusual one. Yet the *Pernetiana* group of Roses is only one among many, and there is no lack of scented Roses in the other groups which are being developed.

Scent can no doubt be controlled by the hybridists as easily as any other character of the flower, and at least one hybrid Rose, the Rose à parfum de l'Haye, has been bred specially for its scent. This Rose was raised by Jules Graveraux from *R. Damascena*, General Jacqueminot, and *R. rugosa* for the rose-water industry in the south of France, and though it does not seem to have been much used commercially, it is the most powerfully scented Rose with the old rose scent that is generally grown. Roseraie de

l'Haye was raised by Cochet Cochet from the same parents for the same purpose.

The Royal Horticultural Society offers every year a cup known as the Clay Cup, for the best Rose with the old rose scent, and the *Daily Mail* has just offered a Gold Cup for the best scented Rose of 1926. So the scent of the rose is not likely to be neglected by the raisers of new varieties.

It is not always easy to judge the fragrance of a rose, for some require a warm, still atmosphere to develop their scent, and do not produce it to best advantage in the open air; this reluctance is common in the Tea Roses, perhaps because their immediate parent, *R. indica* (*Chinensis*) *odorata*, comes from a far warmer climate than our own. Other Roses seem at their best when half open, and rapidly lose their scent under a hot sun; in others the scent is only typical when the flower is fully open. These factors may account for the discrepancies that we often meet in the description of the scent of the same Rose by different observers.

Mrs. Darlington, who contributed a chapter on "Fragrance in Roses" to Mr. H. R. Darlington's book on Roses in the "Present-Day Gardening" series, has very kindly provided the following classified list of fragrant Roses which are in general cultivation.

Old Rose Scent:

Château de Clos Vougeot.
George Dickson.
Roseraie de l'Haye.
Hugh Dickson.
Hoosier Beauty.
Grüss an Teplitz. (This Rose has a special power of scenting the air; its petals, as they fade, smell like pot-pourri.)

Two Varieties of Old Rose Scent:
1. Mrs. Bryce Allen.
   Mrs. John Laing.
2. La France.
   Zéphyrine Drouhin.
   Gustav Grünerwald.

Old Rose and Honey Scent:
Ophelia.
Madame Butterfly.

Cold Cream Scent:
All the Scotch Roses.
Hilda Richardson (H.T.).

Typical Hybrid Tea Scent at its Best:
Madame Abel Chatenay.
La Tosca.
Viscountess Folkestone.
Henrietta.

TEA-SCENTED ROSES:
Gloire de Dijon.
Mrs. Dunlop Best.

Sweet Tea Scent;
Mrs. Foley Hobbs.

FRUIT SCENT:
François Juranville (Wich.).

Apricot Scent:
Many of the *Pernetiana* Roses, especially Rayon d'Or.
Golden Emblem.

Peach Scent:
Goubault.
Catherine Mermet.
The Bride.

HONEY SCENT:
Katherine Zeimet (Dwarf Polyantha).
Yvonne Rabier (Dwarf Polyantha).
Evangeline (Wich.). (Very strong, with a unique power of diffusing itself through the air).

VIOLET SCENT:
Eugénie Lamesch (Dwarf Polyantha).

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Scent and Hybridisation

There is a vague popular belief that when wild plants are cultivated they tend to lose their scent, and it is true that most modern varieties of Sweet Pea, Mignonette, and Sweet William are less fragrant than the older garden forms and their wild ancestors. The falling off is not due to any peculiar effect of cultivation or hybridisation, but rather to the natural tendency of the general public to appreciate a flower chiefly for its colour and form, and to make scent a secondary consideration. For the scent of a plant varies as much as any other biological character, and is affected by hybridisation in the same way, so that the raiser of new forms has it in his power to retain, eliminate, or modify the scent as he will. But he is already preoccupied to control the colour, form, and size of the flower, as well as the habit of the plant, its hardiness and its resistance to disease; so it is no wonder if scent is sometimes allowed to go by the board in the absence of any keen appreciation by the general public.

Luckily, many raisers of new plants have applied their skill and patience to the development of scent. Lemoine, in France, first introduced fragrance into the new double Begonias by using the scented *Begonia Baumannii* as a parent, and J. G. White, working in England, achieved the same result. He describes in *The Garden* (1916, p. 583) how the scent of the *Baumannii* seedlings varied from cinnamon and peppermint to honey and tea rose, and how,

by hybridising these, a muscat, apricot, and wild rose scent was produced.

James Douglas, junior, took the scent of the old clove carnation, intensified it, and combined it with the form and all the colours (except yellow and apricot) of the modern Border Carnation. The history of the Bookham Cloves is given by Mr. Douglas in the *Journal of the Royal Horticultural Society* (vol. xliii., part i.), and he has kindly amplified this in a private communication by adding that, in spite of persistent endeavours for the last ten years, he has never succeeded in combining the clove scent with any shade of yellow, though occasionally a yellow Carnation will carry the "plain carnation scent." It therefore seems as though the carnation scent is made up of two distinct biological characters, the clove element and the plain carnation, which are grouped separately in the chromosomes. In a similar but not identical way the scent of the hybrid pæonies is linked with the colours pink and white of the sweet-scented *Pæonia albiflora*, and it is said that the dark red varieties possess only the poppy smell inherited from the European species, though the writer believes that some dark red scented pæonies have recently been raised. The garden Roses also show an association between colour and scent, which has already been discussed.

Scent has been introduced into the greenhouse Cyclamen in the Sheepwell strain, and a new scent has appeared, apparently spontaneously, in the hybrid Lupins, especially in the Six Hills strain.

The scent of the sweet pea, which has dwindled

away in the modern waved type, may be found strongly in a variety of the old grandiflora form named "Dulce," and raised by H. A. Perkin.

The leaves of the Cape Pelargoniums have several distinct scents, which seem to belong to true species rather than varieties; the leaves of *P. fragrans* smell of nutmeg, *P. tomentosum* of peppermint, *P. capitatum* of rose, and *P. crispum* of lemon. They were at one time bred and selected for their fragrance, and new types of scent were produced, but they have fallen out of fashion now, and it is difficult to obtain specimens of the old named varieties.

The scent of garden forms of scented flowers often varies a good deal from the type without attracting much attention. In the Sweet Sultans, "Bridesmaid" has a strong vanilla scent, "Bridegroom" smells sweetly of musk, and "Honeymoon" of honey.

The Flag Irises (*e.g.*, *Iris pallida*) have generally a vanilla type of scent with a hint of civet, which varies a good deal in the garden hybrids, though not always in the direction of fragrance, for in some a cat or fox smell is stronger than the sweetness.

At least one plant, the Crown Imperial, has been selected for its scentlessness, for there is said to be a garden form of it which is without the smell of fox or over-roasted coffee that some people find so unpleasant.

Pot-pourri

Very few flowers retain their scent after they have been dried, so that the flower petals which make up the bulk of most pot-pourris are little more than a convenient vehicle for the spices and sweet gums

that provide the scent. Rose petals, however, keep a faint fragrance for a long time after they have been dried, especially the thick, leathery petals of the dark red Hybrid Perpetuals, and it is said that the Gallica Rose, which was grown in Provins for making syrups and cordials, did not give out its full scent until it was dead. The "Apothecary's Rose" or *Rosa officinalis*, which is still stocked by a few nurserymen, is probably identical with the old Rose of Provins, and should be the ideal Rose for pot-pourri, though its descendants among the Hybrid Perpetuals may well be as good. Whatever Roses be used, it must be remembered that their fragrance will not withstand the addition of much spice and essential oil.

There are many recipes for pot-pourri; in most of them the proportion of the ingredients is only vaguely indicated, and many include rare balsams not always easily to be identified, but exact directtions for making pot-pourri of proved excellence will be found in Miss Jekyll's book "Home and Garden" (Longmans and Co., 1901).

The scented leaves, especially Lemon Verbena and Monarda, whether alone or in mixture, provide a long-lasting scent if they are slowly dried in the shade, and, to one person at least, there is no pleasanter pot-pourri than a bowl of lavender.

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CHAPTER XI

THE EXTRACTION OF SCENT AND THE MANUFACTURE OF PERFUME

THE simplest and probably the oldest method of obtaining the perfume of a plant is to scrape off the odorous gum as it exudes in tears from the bark, and many of the myrrhs and balsams are still obtained in this way. Labdanum, which is excreted as a sticky resin by the leaves of several species of Cistus (but especially *C. ladaniferus*), demands a more elaborate procedure, and the classical method of gathering it was to drive a flock of sheep backwards and forwards through the bushes, and then to comb the resin out of the fleeces. As a later modification, the bushes were thrashed with special whips made of flat leather thongs; the resin, which stuck to the leather, was scraped off and rolled into thick sticks for export. *Labdanum* was collected in Cyprus by these old methods till quite recent years, and has only lately been obtained by distillation, which is now the chief and almost the only method for extracting the essential oil from leaves, bark, and roots.

Distillation

The plants, enclosed in a wire basket, are placed in a metal still, covered with water, and, in the older method of distillation, heated over a naked fire.

The mixture of steam and essential oil vapour passes out through a tube cooled with running water, in which it condenses, and the essential oil is separated from the water by means of a tap funnel. It is now usual to heat the still by steam under pressure in order to avoid the risk of overheating the plants and giving the oil a burnt smell. But the old method is said to be preferable for lavender, which is, or was till lately, distilled over an open fire in stills made especially wide and shallow to prevent the oil from condensing on the sides and being reheated. The fresh essential oil of lavender has a rough herby scent, which it loses after being exposed to the air for a day or two, and it continues to improve for three or four years if stored away from the light and air. Most essential oils, and especially those of the citrus fruits, are liable to alteration under the action of the light, and it is wise to keep expensive perfumes in a dark cupboard.

Distillation is only applicable to those few flowers whose attar will bear the temperature of boiling water without suffering any considerable change; the flowers must also contain a fairly large amount of attar to make the process worth while. These conditions limit the distillation of flowers in Europe almost entirely to rose and orange blossom. Ylang-ylang ("the Flower of Flowers," *Cananga odorata*) and a few others are distilled in the East.

A large quantity of attar of roses is distilled in Bulgaria and Roumania from a double variety of *Rosa Damascena*, and a certain amount, of very good quality, is said to be obtained in the interior

of Asia Minor (near Lake Burdar) from a single Wild Rose. In the south of France the Provence Rose (*R. centifolia*) is principally used for distillation, though any scented roses that happen to be available in quantity are usually employed as well. The roses in France do not yield as much essential oil as they do in the Balkans, and as a rule distillation is only carried as far as the production of rose water. But an attar, which is said to be of fine quality, has been produced on a commercial scale in Germany from the Balkan variety of *R. Damascena*.

Attar of rose is solid or semi-solid at air temperature, owing to the presence of vegetable wax, but as the wax is quite odourless the thickness of the attar is no criterion of its strength or quality. This wax is present in all scented flowers, and it is probable that it has a useful purpose in holding the scent and preventing it from diffusing away too quickly, a function that is served in the butterflies by the greasy material that coats their scent scales, and in the manufacture of scent by the "fixatives" used by the perfumer. Pure attar of roses has a heavy, sickly smell, and even when dilute does not quite reproduce the scent of the flower, for at least one constituent of the essential oil, *phenyl ethyl alcohol*, is very soluble in water and, after the attar has been decanted off, remains behind in the rose water.

Distillation under reduced pressure, which enables the water and the essential oils to boil at a low temperature, has been tried for the oils which are altered by heat, especially for the citrus oils (lemon, orange, bergamot, etc.), which have hitherto been

obtained by submitting the grated rinds to hydraulic pressure, or by dexterously squeezing slips of peel by hand over a sponge.

Extraction with Volatile Solvents

The most modern method of extracting the scent of flowers is to wash the petals repeatedly with a volatile solvent, such as petrol-ether. The solvent, when sufficiently charged with scent, is distilled at a very low temperature under reduced pressure, and used again for further extractions. Left behind in the still is a semi-solid waxy substance, known as a *floral concrete;* for use in perfumery this is washed with alcohol, which dissolves out the essential oil from the odourless vegetable wax or *stereoptene.* If the alcohol is removed from the washings by distillation under reduced pressure, the pure essential oil of the flower is obtained; this is known as a *floral absolute,* and, when diluted to the right degree, gives almost exactly the scent of the flower.

Enfleurage

In some plants, such as Jasmine and Tuberose, the scent does not exist as such in the flower, but is given off slowly so long as the petals remain alive. If the flower is killed by heat or a volatile solvent, only a very small amount of essential oil is obtained, and it is found to lack one or two of the constituents (*indol* and *methyl anthranilate*) of the natural essential oil. It is therefore necessary to capture the scent as it is given off by the living flower, and to do this the perfumer exploits the property of fatty sub-

stances, well known to every housewife, of absorbing the scent of any odorous bodies in their neighbourhood. The flowers are spread out on sheets of glass smeared with a layer of suet, and these, which are set in shallow wooden frames, are piled one above the other to form a series of closed compartments. The flowers are renewed at intervals of twenty-four or forty-eight hours, until the grease is saturated with the scent, which may require twenty or more changes. The scented fat is finally scraped off the glass, chopped finely, and extracted with alcohol. This method of extraction, which is known as enfleurage, produces a very fine and delicate perfume, and can be used where only small amounts of flowers are available at one time, but it is very slow, and needs a great deal of labour. Various modifications have been tried to make the method less laborious. An apparatus was introduced for blowing a current of damp air through the flowers, and then through an oil, but it proved unsatisfactory, though it is said to have been used with success in the reverse direction, for scenting flowers before they were sent to the market. The old method is still employed in the south of France almost exactly as it was a hundred years ago, principally for Jasmine and Tuberose, but also for Jonquil, Lily of the Valley, and Mignonette.

Maceration

For some flowers the process can be shortened by steeping them in melted fat, and this method, which is known as maceration, is used for Violet and Mimosa, and sometimes for Rose and Orange blossom.

The Art of the Perfumer

The essential oils, however carefully prepared, seldom have quite the same scent as the flowers from which they were obtained. The delicate balance of their many and various constituents is necessarily disturbed by the process of extraction, and some elements may be lost altogether. The scent is also presented to us under quite different conditions; in the flower it is given off slowly, and the components of the essential oil are, to some extent, held together by the wax of the petals, but in the extracted essence the scent as a whole is apt to be very fugitive, and the more volatile oils are given off first.

It is here, after the extraction of the scent, that the art of the perfumer really begins; his first task is to adjust the balance of the scent and to supply if necessary, those elements that have been lost. This may be done by adding either some essence in which the required quality is very strong, as an extract of violet leaves is used to give a cool, leafy quality to a violet perfume, or by adding a single substance which will give the note required. This last may have been isolated from one of the essential oils or prepared synthetically in a laboratory.

There is a prejudice of the general public against these artificial scents which is hardly reasonable, since we may fairly judge the artist-perfumer only by his results, and to dictate the means that he should employ is no more logical than to limit the flower painter to the use of vegetable colours.

The artificial scents are sometimes regarded as merely inferior substitutes for the natural product, and their use is held to imply a kind of falsification of the flower scent. This criticism is only justified in so far as a single artificial scent substance never gives, if only on account of its purity, an exact reproduction of a flower scent; but to use it as such would be an example of bad art which would fail on its own demerits, and is not likely to occur.

The artificial perfumes are of more various origin than is, perhaps, commonly supposed. Some are isolated from essential oils which happen to contain them in large amounts. Some are produced from natural scent substances by carrying out in the laboratory the chemical processes by which the required substance is manufactured by the plant itself, and in this way *citral* (lemon) is converted into *geraniol* (rose). Some are obtained by isolating the required substance from its mixture in the natural essential oil, determining its exact chemical constitution, and then building it up from the simpler compounds. Occasionally a valuable scent has been discovered accidentally by a research chemist, but more have been produced by altering a scented chemical compound along likely lines.

A lucky accident contributed to laborious research in the first production of artificial violet. Tiemann and Kruger set out to isolate the active substance of the scent of violet, and as the essential oil of violet is procurable only in minute quantities, they worked with oil of orris root on the assumption (which proved to be incorrect) that the scent of

violet and orris were due to the same substance. They obained the substance *irone*, but when they endeavoured to reconstruct it they produced its isomer, *ionone*, whose scent is far more like violet than is the scent of *irone*, and is almost certainly the substance to which the sweetness of violet is principally due. Unfortunately, but as might be expected, *ionone* by itself does not reproduce the scent of the violet.

When the perfumer, guided by his trained sense of smell, has built up and rounded off the perfume to his liking, he adds some fixative to replace the wax or resin that was originally present in the plant. The fixatives are bodies that are only slightly volatile, and they may be either odourless or scented. In the old days the animal scents, musk, civet, and ambergris, were chiefly used, but as the first two of these are very powerfully scented, and the last, owing to its rarity, has obtained a fantastic value, they are not much used by the modern perfumer unless the particular "note" of their scent is required. As fixatives they have been largely replaced by preparations of different sweet gums and oleoresins, which are selected to harmonise with the dominant quality of the perfume, or by artificially prepared fixatives which have no scent of their own. The effect of adding a fixative may be compared with that of stepping back from an Impressionist picture: the mosaic of apparently unrelated elements suddenly fuses into a complete design. The fixative, besides helping to blend the perfume, makes it less fugitive; but there are limits to its powers, and the

scent of very volatile essential oils can never be made "permanent" as the scent of "Chypre," "Ambar," and "Patchouli," which depends upon resinous substances, is "permanent."

The Manufacture of Scent at Home

With patience, the scent of any flower can be extracted at home by enfleurage, and the only real difficulty is the preparation of a completely odourless fat; but, owing to the high cost of alcohol, the product is not very cheap, and we must remember that, although we shall obtain a sweet scent, it will probably not be exactly like that of the flower. The following procedure has been used by the writer with moderate success: Three parts of beef suet and one of lard are boiled with water containing one teaspoonful of alum to the quart, well stirred and strained through muslin. This process is repeated till the fat is quite odourless. In the south of France poplar buds, or a little gum benzoin, are macerated with the fat in order to prevent it from becoming rancid, but they are hardly necessary if it is used immediately. The fat is finally allowed to cool, when it is separated from the water, remelted, and poured in a thin layer into soup plates or shallow dishes. Before it is quite hard the fat should be scored into ridges. The flowers, which must be quite dry, and free from stalks and leaves, are piled in a double layer on the fat, and covered with another plate lined with fat. The flowers are left on the fat for twenty-four hours, and changed until the fat retains a strong scent after the flowers have

been removed for some hours. The scented fat is chopped fine, placed in a stoppered bottle, and covered with about its own bulk of spirits of wine, or, preferably, 90 per cent. alcohol. It is left for three months in a dark cupboard and shaken as often as possible. At the end of this time the scented alcohol, which is our floral extract, may be filtered off, and with the addition of a fixative, such as a trace of oil of cedar or sandal wood, will be ready for use.

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CHAPTER XII

HISTORY

IT is tempting to think that our ancestors prized the scent of flowers more highly than we do, but here we are not on very sure ground; we know a good deal about herb gardens of the Middle Ages, and even of Anglo-Saxon times, but the garden of pleasure as an appanage of the Court and nobility was usually described with respectful vagueness and paradisiacal epithets.

Albertus Magnus, Bishop of Cologne in the thirteenth century, gives directions for making a pleasure garden, which, since most of it was lawn, he calls a "viridarium," and he stresses, rather from the hygienic point of view, the importance of fragrance. He says:

"Care should be taken that the lawn be of such size that all round the edge of it may be set aromatic plants, such as Rue, Sage, and Basil; likewise flowers of all kinds, such as Violets, Columbine, Lily, Rose, Iris ('gladiolus'), and others. And at the end of of the lawn, between these plants and the grass, let there be a raised square of soft and flowery turf to serve as a bench upon which men may sit and pleasantly rest themselves.

"The lawn is to be shaded by trees, but care must be taken that they are not bitter trees, such as the nut tree (? walnut) and certain others; for there are trees with sweet and aromatic flowers, whose shade

is wholesome, such as vines, pears, apples, pomegranates, bay, cypress, and the like.

"Beyond the lawn let there be a great variety of medicinal and aromatic herbs, which will not only delight the sense of smell by their fragrance, but refresh the sight by the diversity of their flowers, and draw the admiration of all who behold them.

"Let plants of Rue be mixed with them in many places, for it is of a pleasant green colour, and by its bitterness will keep venomous beasts out of the garden.

"There should be no trees or plants in the middle of the lawn, for the very openness of it is enjoyable on account of the clean free air, and that air is the most wholesome.

"If possible, let there be a very clear spring in the middle, for its purity will give much pleasure.

"Recreation, and not fruit, is to be sought for in the viridarium." ("De Veget. et Plantis," lib. vii., cap. xiv.)

The Bishop was a man of immense book learning, and his garden may be an academic ideal rather than a typical German garden of the thirteenth century, though it corresponds closely with the pleasances that we see in the old illuminated manuscripts.

The turf bench, which was almost invariably found in the pleasance, has been revived, in another form, by one of our rock garden designers as a shallow seat in a turfy bank lined with prostrate Thymes.

Throughout the Middle Ages gardening was restricted by the stress of war and the difficult conditions of life, and men grew more vegetables and medicinal herbs than flowers, which hardly

flourished except in the shelter of monasteries and castles.

It was not till Tudor times that a flower garden became general, and from now onwards we find the gardeners Gerard, Parkinson, and their successors, describing the scent of the flowers they grew with careful interest. They had fewer flowers than we have, and so, perhaps, they were more alert to appreciate all their qualities. They also lived in a malodorous and insanitary age, which may have enhanced the value of fragrance. There were no floral perfumes except rose water, and all perfumes were costly to buy, so the garden was called upon to supply the material for sweet waters distilled at home—Rose, Lavender, Balm, Rosemary, Angelica, and coarser scented-leaves such as Sage, Rue, Thyme, Wormwood, Tansy, Chamomile, etc.; these took the place of our scented soaps and, to some extent, of our disinfectants.

New plants were continually arriving from the Continent and the new colonies, variations from type were eagerly selected and, although artificial hybridisation had not yet been discovered, a great number of florists' flowers were created.

Flower gardening received a slight check at the beginning of the eighteenth century, for the landscape gardeners cared nothing for flowers, either fragrant or scentless, and bundled them into the kitchen garden, where they did not exterminate them altogether. But the new fashion could only be expressed in the gardens of the wealthy, and although its effect was profound, it was far from

general; so the smaller gardens continued to develop along the old lines.

Towards the end of the eighteenth century the cult of the Rose entered into a new phase, and began to grow with an energy that has never flagged. It began with the production in France of new hybrids between the Damask and the Gallica Roses, followed by the introduction of *Rosa indica* (*Chinensis*), which gave us the China monthly Roses, and, in the earliest years of the nineteenth century, the first of the grand scented race of Hybrid Perpetuals. In 1824 the yellow *R. indica* (*Chinensis*) *odorata* arrived in Europe, and brought a new scent to the garden, for it was soon crossed, in France, with the old pink variety of *R. indica*, and gave the first Tea Rose.

The garden gained another new scent in 1700, a when few seeds of the Sweet Pea were sent to England from Sicily.

The cultivation of fragrant flowers received another slight check, about the middle of the Victorian era, from the vogue of carpet bedding, which appealed—if the word can be used of so assertive a fashion—to the eye alone, and banished many sweet-scented plants from the larger gardens. They were not lost—for here, again, the fashion was followed only by the wealthy—but found a home in the smaller gardens, cultivated mostly by their owners, which have always been a safe repository for good garden plants temporarily out of fashion. Carpet bedding has gone, lingering on only in a few public parks, where it has already something of the artificial charm of an antique; but a generation

repenting of the sins of its fathers tends, rather unfairly, to proscribe the whole practice of bedding out, though the garden owes to it the sweetness of *Cherry Pie*, *Double Stocks*, *Tobacco Plants*, and *Humea elegans*.

A strong reaction against the standard ideals of Victorian gardening set in towards the later part of the nineteenth century, and gave what may be called the Natural School of gardening. This restored the scented flowers to their old position, since plants were once more appreciated for their individual qualities and not for their mass effect.

An enthusiasm for gardening is growing steadily and strongly; with it there seems to be an increased appreciation of the scent of flowers. We have seen the attention paid to it by the flower raisers, and it is significant that the most popular shrub of recent introduction, *Viburnum Carlesi*, owes most of its beauty to its scent. The public has become almost alarmed by the scentlessness of some Roses, and the *Daily Mail* has just offered a Gold Cup for the best scented Rose of 1926.

There is at present a slight but distinct reaction towards formality in the garden, which has brought back one or two florists' flowers, whose formal elegance was incompatible with a zeal for the wild species and natural forms. Some of these are very sweetly scented—the double Rocket, double Night-scented Campion (*Lychnis vespertina fl. pl.*), *Saponaria officinalis fl. pl.*, and the old double Wallflowers. They are often seen in old gardens, and they have now found their way once again into the catalogues.

The Older Civilisations

Scented flowers are more to hand in the warm climates of the East than in Northern Europe, where most of them need some care in cultivation, and they have always played a large part in the daily life of the people, especially in religious ceremonies. The Jasmine, Lotus, and Champac are the classical flowers of India; they are mentioned in the earliest records, praised by the poets, and to-day the honoured guest is hung about with garlands of Jasmine. They are heavy-scented equivalents of our lighter Rose and Violet.

The garlands, which were so important to the Greeks and Romans, have dwindled down in our Western civilisation to flowers on the dinner table, and the button-holes, which seem to be going out of fashion. Perhaps ours is the better way, for the "swift fading garland" was a wasteful use of flowers.

The Egyptians were great gardeners and very fond of flowers, but they do not seem to have selected them for their scent. *Nymphæa stellata*, the Egyptian Lotus (the white night-flowering *N. Lotus* is rarely found in the dried garlands, and *N. stellata* was evidently the more popular), is sweetly scented, but its size and beauty, together with its association with the Nile and the rising sun, would account sufficiently for its popularity. The Rose seems to have been unknown in dynastic Egypt; at least it was not valued enough to find a place in the funeral garlands and the frescoes, al-

though the Egyptians must, almost certainly, have met it in their traffic with the Middle East.

The ancient Jews cannot have cared very much for flowers or they would have had more than one word to describe them. They may have grown the Rose, but they do not mention it, and the commentators say that the "Rose of Sharon" may have been *Narcissus tazetta*, though more likely it was a general poetic description. Yet the Persians gave the Hebrews their word for a garden, which we have received in turn as the word "paradise," and Persia is the home of the Rose (see "Das Rosenbuch," Wilhelm Mützе and Camillo Schneider, 1924). It had more than a conventional place in Persian literature, and rose-growing was almost a national industry.

The earliest records of flowers would be more interesting if we could be always sure of the identity of the plants mentioned, but this is very often uncertain, for the descriptions are usually meagre, and plant names have always been used loosely. The Greek *ἰον* came, almost certainly, to mean our Violet, but Homer uses it for some purple flower that grew in marshy meadows. Both *ἰον* and *οἰνον* (and also *viola* and *vinum*) seem to contain the same root, meaning to twine; implying in the Vine a climbing plant, and in the Violet perhaps a flower used for weaving into garlands, though "violet" may mean only the "wine-coloured flower." It is probably only a coincidence that the scent of the violet and vine flower belong to the same group. Both *Elecampane* and the Golden Garlic (*Allium Moly*) claim to be the plant with which Odysseus protected himself against the

charms of Circe, but the Garlic would be more likely to prove efficacious and to have appealed to so practical a man as Odysseus.

History of Perfumery

The ancient perfumers had no spirits of wine or strong alcohol in which to dissolve the essential oils, so that their perfumes were all made up with a basis of olive oil or oil of Behn, and were therefore described as unguents or ointments. They had very few floral perfumes, though even in pre-classical Greece they had learnt to extract the scent of roses by the first stage of enfleurage, and the rose oil with which Aphrodite anointed the body of Hector was no doubt prepared by steeping the petals in oil and then wringing them out by hand, as Theophrastus describes in 300 B.C. Theophrastus mentions unguents also of Narcissus and Susinon, which was probably the Madonna Lily.

The primitive flower perfumes were probably faint and liable to decompose, so that a very high value was placed on the Myrrhs (*Commiphora spp.*) and Olibanum (*Boswellia spp.*), for these provided a powerful, lasting, and portable perfume, whose scent approximated to that of the flowers in sweetness, but needed no other preparation than to be scraped off as it exuded from the trees. They came mostly from Arabia, and rarity added to their fabulous value. Balm of Gilead (*Commiphora sp.*) is only found in the tropical depression of the Jordan Valley; unlike the other Myrrhs, it has an added lemon scent and has given its name to the lemon-scented garden

Balm. *Cedronella triphylla* (lemon and camphor scent), is sometimes known as "Balm of Gilead."

The ancients seem to have been more tolerant of heavy animal scents than we are, but when we recall the value that they set upon spikenard, valerian, musk, civet, and ambergris, we must remember that very few flower scents were available.

Spikenard was immensely popular, and its remote origin in the Himalayas made it very costly. Pliny gives the formula of the "ointment of spikenard very precious," which contained, besides the spikenard (*Nardostachys jatamansi*), Juncus (probably *Andropogon lanigerum*, rose-scented), Costus (see p. 74), Cardamoms, and Myrrh. It would smell chiefly of the patchouli-scented *Nardostachys*.

Rose water was the first scent to be obtained by distillation. In A.D. 810 the Persian province of Faristan paid a tribute of 30,000 bottles of rose water to the treasury of Baghdad, and rose water was exported as far as China and Morocco. Attar of roses was produced accidentally in Persia about 1612, and was the first essential oil to be obtained in a pure state, for although the alchemists must almost certainly have produced essential oils in the course of their distillations, they would have thrown them away as belonging to those grosser humours from which they were seeking to purify their preparations.

The forerunner of Eau de Cologne appeared in the seventeenth century in the "Eau des Carmes," which the Carmelite monks of Paris distilled from Balm, Lemon Peel and Lavender. But a similar preparation, the "Eau de la Reine d'Hongrois,"

with which Elizabeth of Hungary restored her beauty, must be still older, for if the account that George Borrow's tall Hungarian friend gave him in the inn at Horncastle be true, the Queen received the formula from a hermit at the end of the fourteenth century. It is a spirituous distillate principally of Rosemary, with the addition, according to a recipe given by Piesse, of Balm, Lemon peel, Mint, and rose water. It may still be bought in London.

Medical

Scent, as something invisible yet strongly felt, has always excited the interest of mankind, and a certain magic power has often been attributed to it. Sweet-scented substances were supposed, by their tenuousness and subtlety, to act directly upon the brain, and were held to be, in a general way, antidotes to disease. For the cause of disease, if not the disease itself, was often pictured as a noisome, pestilential vapour, and a sweet scent, being similar in nature but opposite in quality, was reasonably supposed to counteract it. Since sweet scents stimulate the physiological mechanism, though it may be but slightly, it would be rash to say that they are altogether useless in medicine. Musk is still occasionally used as a stimulant in modern medicine, but most of the essential oils in the Pharmacopœia, cloves, ginger, cinnamon, dill, cardamoms, etc., are more valued as carminatives—"gallant expellers of the wind," an old physician calls them—than as general stimulants. Musk, spikenard, sumbul, gingseng, and other scented substances are highly

esteemed in the East as aphrodisiacs, not altogether without justification.

Another train of thought, which imagined disease as an evil spirit that had temporarily taken possession of the patient, led, quite logically, to the use of noisome drugs in order to drive out the spirit by making his habitation uncomfortable, and Assafœtida and Valerian still linger on in modern medicine as "antispasmodics."

Assafœtida occurs in the Assyrian herbal, the oldest pharmacopœia of which we have a record, together with Sweet Flag, Galbanum, Liquidambar, Myrtle, and other aromatic substances (see R. Campbell Thompson, "The Assyrian Herbal," privately printed, 1924). The author identifies one word, "ma-kasi," as "rose water," which might indicate that Roses were distilled in the earliest civilisations; but it must be remembered that a simple infusion of rose petals might be, and often was, described as rose water.

When we look closely at the value that we set upon flowers it seems to contain something more than æsthetic appreciation, for an artificial flower, be it never so decorative, makes a different, and usually smaller, appeal to us than the living original. The living flower has some quality which defies imitation, and it is this quality which determines the ceremonial use of flowers even to-day. Some hint of what this quality may be can be found in the symbolic value that is focussed upon the Lotus, the Lily, and the Rose, which have been the vehicle for approximately the same idea over many centuries for many different

races. The idea symbolised, which appears most clearly in the Lotus, is that of the continuity of life.

The Lotus is more particularly a birth symbol, standing for a chalice or casket enclosing the principle of life in a potential phase, not yet manifest in any material form.

It will be noticed that the three great symbolic flowers are fragrant, and it can hardly be doubted but that the scent, invisible, pervasive, and deeply stirring, contributes to the value of the symbol, if it be not identified with the idea symbolised, the principle of life itself.

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APPENDICES

APPENDIX A

Attar of Neroli (Orange Blossom)

Linalool	.. 30 per cent. (lily).
Linalyl acetate ..	.. 7 per cent. (bergamot).
Geraniol, Nerol	.. .. 4 per cent. (rose).
Phenyl ethyl alcohol	.. (rose).
Geranyl acetate, Nerol acetate	.. 4 per cent. (rose).
Terpineol ..	.. 2 per cent. (lilac).
Methyl anthranilate, Indol	0·6 per cent. (heavy).
Farnesol	(lily of the valley and cedar wood).
Decylic aldehyde.	
Jasmone.	
Nerolidol ..	.. 6 per cent.
Terpenes ..	.. 35 per cent. (odourless).

(Gildemeister and Hoffmann, *op. cit.*)

Oil of Petit Grain

(From the leaves and twigs of the bitter orange.)

Linalyl acetate.
Linalol.
Geraniol.
Nerol.

(Gildemeister and Hoffmann.)

Attar of Gardenia

Benzyl acetate (preponderant, resembles jasmine).
Methyl anthranilate.
Linalyl acetate.
Linalyl.
Terpineol.
Styrolyl acetate (characteristic).

(Otto: "L'Industrie des Parfums.")

Oil of Lavender

Linalyl acetate, 30 to 45 per cent.
Linalyl butyrate.
Linalyl valerianate.
Geraniol.
Nerol.
Eucalyptol.
Ethyl amyl ketone.
Pinene (a terpene). (Otto: *Op. cit.*)

APPENDIX B

SCENTED PLANTS FOR A SMALL GARDEN (ONE ACRE OR LESS)

Shrubs

Viburnum Carlesi.
Osmanthus Delavayi.
Berberis dulcis nana (honey and rose).
Buddleia variabilis var. Nanhoensis (hyacinth-lilac).
Daphne Mezereon.
Daphne Cneorum.
Philadelphus microphyllus (quince and melon).
Philadelphus hybrid, "Erectus" (pineapple and orange blossom).
Lonicera syringantha (hyacinth).
Lonicera fragrantissima (oranges).
Magnolia parviflora.
Roses.

Smaller Plants (Perennial)

Lily of the Valley.
Violets.
Cyclamen Europæum.
Border Carnations.
Pinks.
Double Rocket (night-scented).
Phlox (herbaceous).
Double wallflowers.
Hemerocallis (heavy).
Iris stylosa.
Iris pallida.
Pæony, "Duchesse de Nemours," "Marie Lemoine," "Gloria Mundi," etc.
Lychnis vespertina fl. pl. (night-scented, heavy).
Primula auricula, "Dusty Miller."
Cowslips.

Smaller Plants (Annual)

Mignonette.
Night-scented Stock.
Schizopetalon Walkeri (night-scented).
Sweet Pea, "Dulce" and other Grandiflora vars.
Sweet Sultan.

Bulbs

Muscari botryoides.
Muscari conicum.
Muscari moschatum (warm, light soil).
Triteleia uniflora.
Crocus longiflorus.
Crocus speciosus.
Crocus imperati.
Crocus hadriaticus.
Crocus chrysanthus.
Jonquil.
Narcissus juncifolius.
Pheasant's Eye Narcissus.
Tulipa persica (Hawthorn type).
Tulipa florentina.
Tulip, "Miss Willmott" and others.

Scented Leaves

Lavender.
Rosemary.
Balm (Melissa officinalis).
Monarda dydima, "Cambridge Scarlet."
Thymes, including Th. azoricus (tangerine) and Th. Herba Barona (carraway).
Aloysia citriodora (warm wall).
Lavender cotton (Santolina incana).
Southernwood (Artemisia Abrotanum).
Veronica cupressoides.

For a Wall

Honeysuckle (north).
Jasminum officinale.
Azara microphylla.
Wistaria.
Clematis flammula.
Clematis, "Fair Rosamond."
Clematis, "Duchess of Edinborough."

For a Trellis or Low Hedge

Sweet Briar.
Penzance Briar.

APPENDIX C

SWEET-SCENTED FLOWERS IN AUTUMN

Buddleia auriculata (Aromatic group, carnation type).
Clematis flammula (Aromatic group, almond-hawthorn type).
Clerodendron trichotomum (Heavy group, resembles the Pheasant's Eye Narcissus. The leaves, when bruised, have the " roast beef " smell of Iris fœtidissima, mixed with elder bark).
Clethra alnifolia (Aromatic group, with a suggestion of lilac).
Crocus longiflorus (Primrose type).
Crocus speciosus (Primrose type).
Crocus hadriaticus (Primrose type).
Cyclamen europæum.
Eupatorium Weinmannianum.
Herbaceous Phloxes.
Mirabilis Jalapa (Fruit-scented group).
Sternbergia lutea.
Roses.
Violets.

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